Mining
CONGRESS JOURNAL

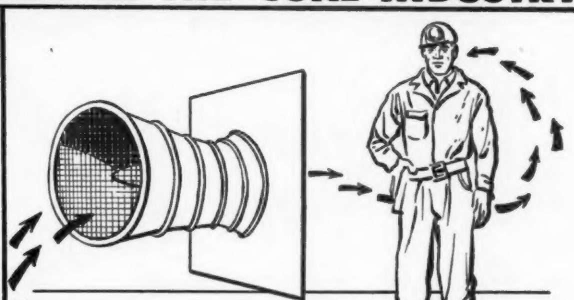
AMERICAN MINING CONGRESS

AMC

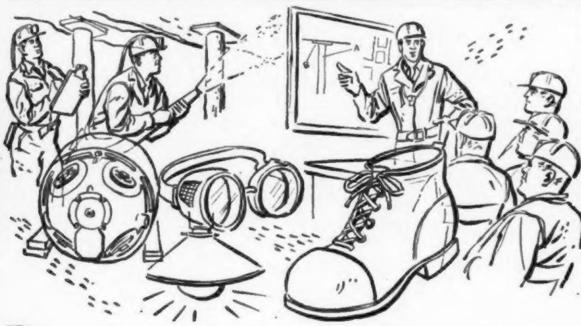
JUNE
1949

Coal Facts #2.. ..A ONE MINUTE *QUIZ*...FOR MEN IN THE COAL INDUSTRY

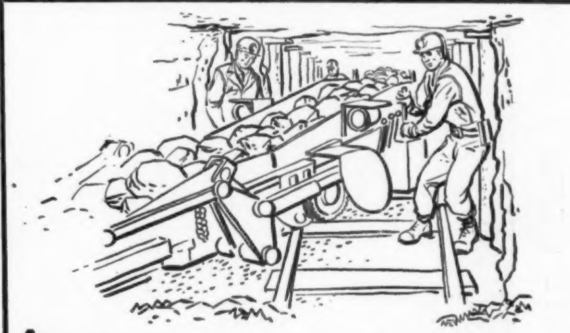
1. What is the largest single cause of coal mine accidents? ☐ Explosives ☐ Falls of roof and coal ☐ Dust and gas explosions



2. What is considered a safe volume of underground air per man, per minute? ☐ 175 cu.ft. ☐ 500 cu.ft. ☐ 58 cu.ft.



3. Many major steps are being taken to make mines safer. Can you name 5?



4. What loading machine is always safe for operation in narrow places?

Answers:

1. The U. S. Bureau of Mines lists the causes of accidents in order of fatalities as follows: 1. Falls of roof and coal; 2. Explosions from gas and dust; 3. Explosives, machinery, electricity and other causes.

2. Individual state requirements vary between 150 and 200 cu. ft. per minute per man for an average of approximately 175 cu. ft. Many mines provide more than this, and all mines provide more where noxious and dangerous gases exist.

3. Seven important steps now being taken by many mines include: Instruction Courses, Inspection, Use of permissible explosives, Use of government approved permissible motors and control equipment on machines at the face, Regulations against inflammable articles, Safety crews, Rock Dusting and Spraying and, Use of safety equipment for miners such as safety shoes, helmets, goggles, lamps and better lighting.

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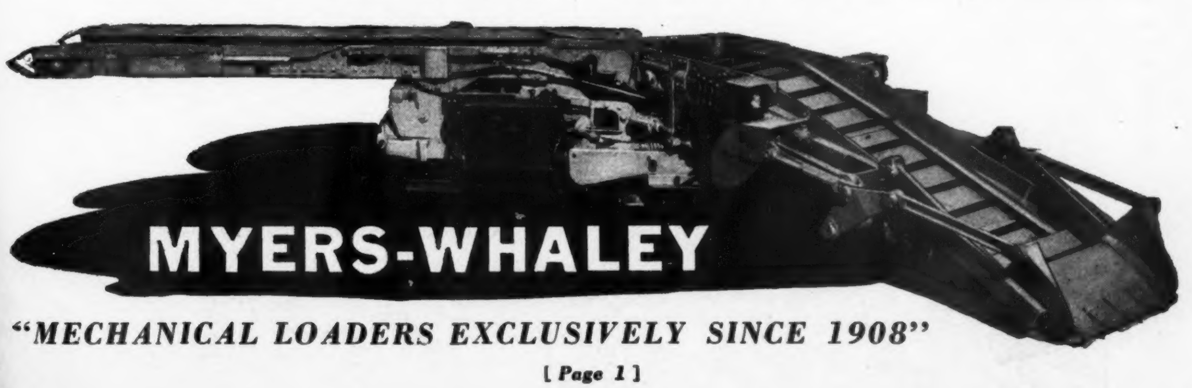

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Room Conveyors (top-left) discharging onto a Jeffrey butt entry sectional belt conveyor. Discharging into mine car at the main entry is the other end of this conveyor (bottom-right).

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THE AMERICAN MINING CONGRESS
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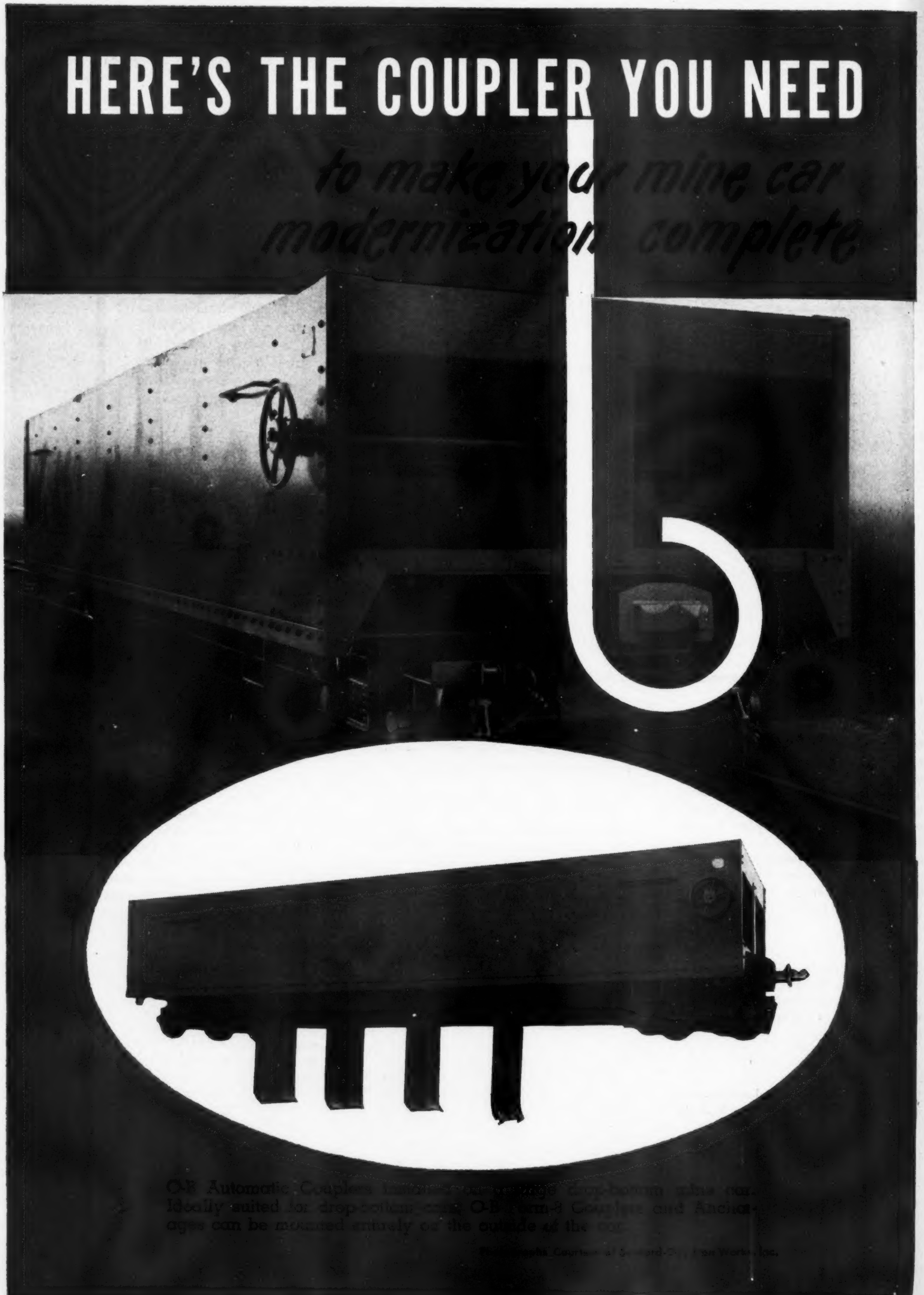
ABC
Member Audit Bureau of Circulations

To All Owners of GOODMAN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3022—AM

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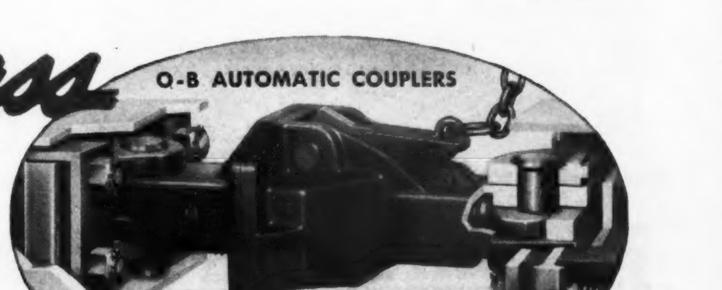

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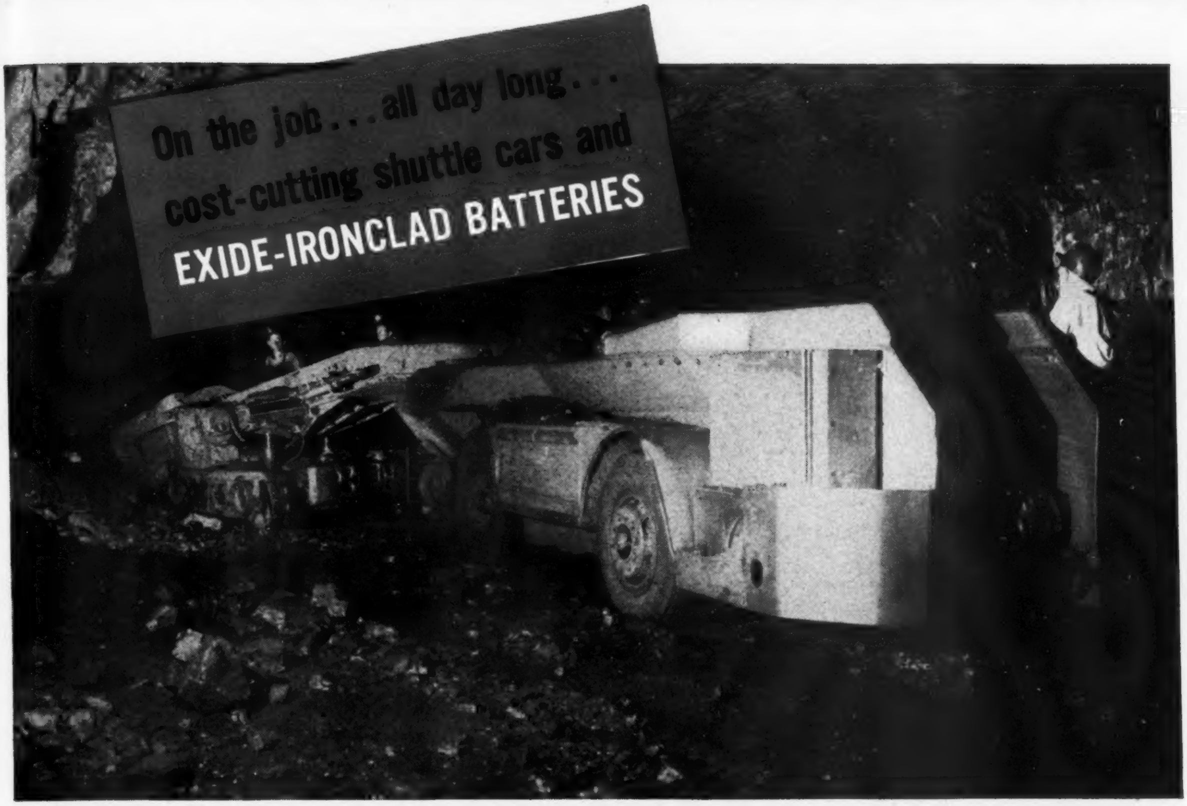

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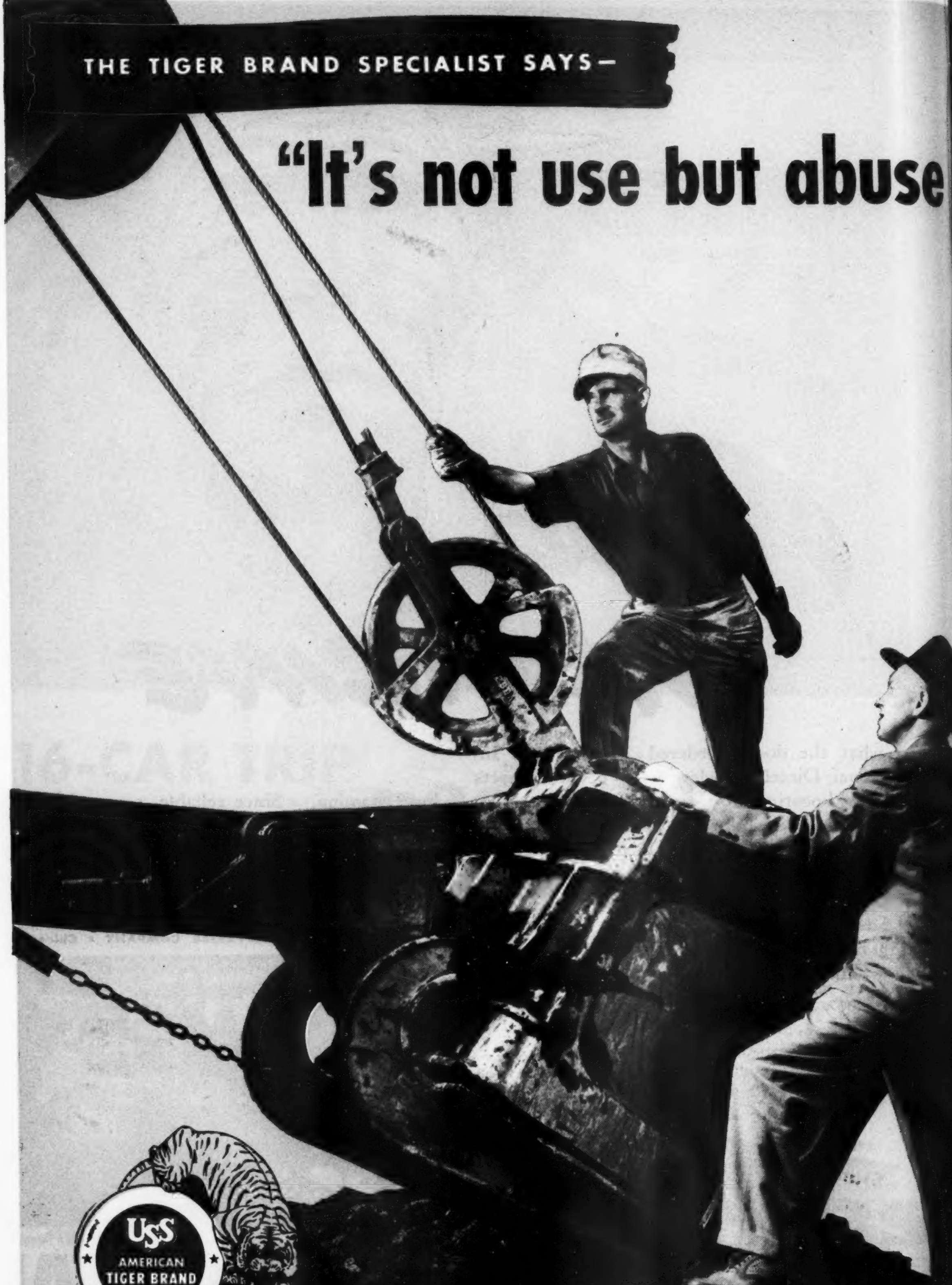
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Editorials

SHELDON P. WIMPFEN, *Editor*

June, 1949

Count the Cost!

IN AN analysis of the labor and supply costs entailed in the mining of lead and zinc, W. C. Page, assistant general manager, United States Smelting Refining and Mining Co., told the annual meeting of the American Zinc Institute how these operating costs per ton have increased since 1939. His paper was based upon data provided by a number of mining companies representing a cross-section of the Eastern, Central, and Western States.

Mr. Page dramatically illustrated how average labor costs per ton for the lead-zinc mining industry increased in 1948 to 2.35 times the average 1939 costs. The greatest increase, 2.9, took place in the Western District, while the smallest increase, 1.85, occurred in the Central District. This difference reflects the intensive degree of mechanization in the Central District.

Supply costs per ton mined showed an average increase to 2.13 times the 1939 costs, with the Western District again showing the highest increase, 2.65; the Central District had the smallest increase, 1.75; costs in the Eastern District increased to 2.0 times the 1939 level.

During the same period production per man hour had increased an average of 1.55 times, largely due to the widespread application of mechanized and improved equipment. Mr. Page pointed out that, in 1939, the total labor cost per ton mined in the lead-zinc mining industry was approximately 55 percent of the total operating cost per ton. In comparison, the 1948 total labor cost is closer to 70 percent of the total operating cost per ton mined. Projecting the curve of increases, total labor costs per shift today are approximately 2.5 times the 1939 costs. Taking the total labor cost as 70 percent of the total operating cost, a 2.5 times increase in labor costs indicates that current over-all operating costs per ton have increased to 2.05 times those of 1939.

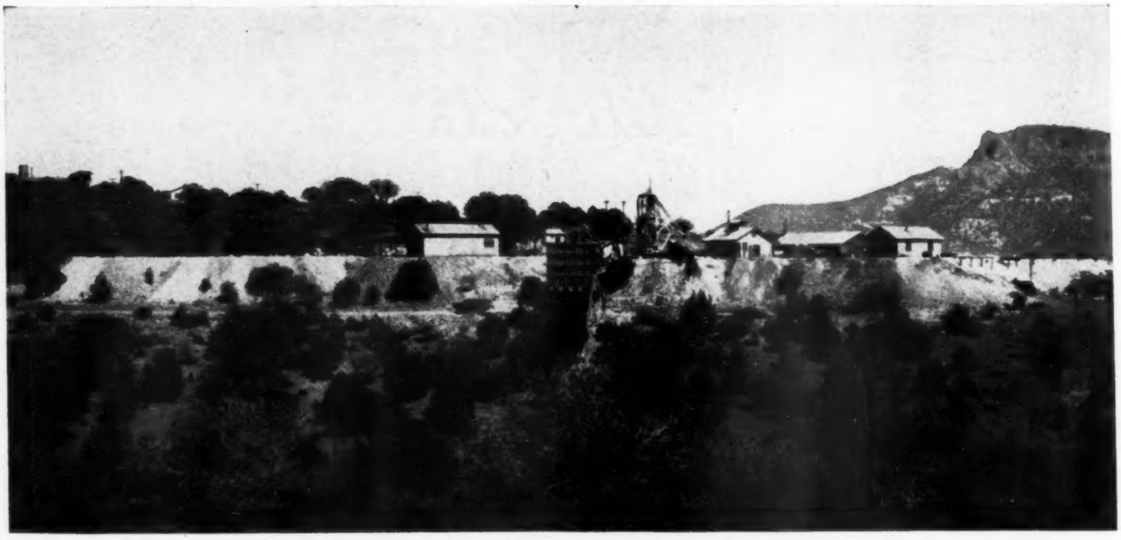
These data become even more significant when compounded with the changes in ore grade which have occurred in the last decade. "Old Timer," writing in the *Salt Lake Tribune* of April 24, states that in 1939 the average zinc-lead content per ton of ore in the Rocky Mountain Region was 16 percent. He adds, "The average combined metal content in 1948 had dropped off to an estimated 10 percent.

"In other words, if the labor costs for mining 320 lb of metal in the average ton of ore in 1939 is taken at $6.00 (a close figure), the labor cost per pound of metal was 1.88c, then since the 1948 labor cost per ton of ore containing 200 lb of combined metal was 2.9 times the 1939 labor cost per ton, we have 2.9 times $6.00 divided by 200, or a labor cost per pound of metal of 8.7c."

This skilled observer has put his finger on the crux of the situation. In the Rocky Mountain Region, the 1948 labor cost per pound of contained metal was 4.6 times the 1939 mining cost and not 2.9 as might be assumed if one neglected to take into consideration the declining average grade of ore.

Lower ore grades are general, not only in lead-zinc deposits, but in copper, iron, antimony, tungsten, mercury, gold, manganese, chrome, vanadium, etc. They will, on the average, continue this falling trend.

Add to all this the increased cost of concentrating, refining, and freight and try to strike a balance between costs and current depressed metal prices. How long can these counter trends continue?



Surface plant of the Kearney mine, Hanover, N. M.

Tungsten-Carbide Bits at the Kearney Mine

High Speed Drilling Cuts Costs at New Mexico Consolidated Mining Co.

By JOSEPH H. TAYLOR
Vice-President
Peru Mining Co.

IN THE spring of 1947, having heard of the remarkable results obtained by using drill steel tipped with tungsten-carbide inserts, an attempt was made to get some of these bits for experimental use. After failing to obtain them at that time, some bits were made on the job by inserting tungsten-carbide or high-speed steel as a cutting edge in detachable bits. The results were not satisfactory although one of these bits drilled considerably more than the ordinary detachable bit. In October 1947 the Ingersoll-Rand Co. supplied six of their Series 13, 1½-in. Carset bits. These are detachable bits with tungsten-carbide inserts. They also sent sets of 1¼-in. hollow round rods and 1-in., quarter-octagon rods with 13/16-in. studs for use with drifters and stopers.

These bits were tried out in drifting and drilled a hole 1 9/16 in. in diameter. In drilling at the Kearney mine the previous practice was to start holes at 2¼-in. diam and finish them at 1½-in. diam. The new bits were 1½-in. gauge and it was found that they would drill considerably more per minute than the ordinary detachable bits. Of the first four bits used, one drilled 73 ft, one drilled 177 ft, one drilled 352 ft, and one drilled 382 ft before failure. This is an average of 246 ft per bit, drilling in fairly hard rock—zinc ore with a garnet gangue.

All this work was done by an experienced machine man under the direction of Joe Tompkinson of Ingersoll-Rand. The work was so satisfactory that 25 tungsten-carbide bits and several sets of alloy drill steel were ordered and several of the miners assigned to use these bits in regular operations.

Tests were conducted during November 1947 in which the miners drilled a hole with conventional steel or detachable bits and then a hole with tungsten-carbide bits so as to compare the elapsed drilling time. The average time with conventional steel was nine minutes, twelve seconds, to drill a hole 6 ft deep. With tungsten-carbide bits three minutes, thirty-nine seconds were required to drill a hole 6 ft deep. This shows that drilling time with conventional steel or detachable bits is two and one half times as long as with the tungsten-carbide bits. During October and November 1947, 3996 ft of hole were drilled using the original 6 bits and 15 purchased bits. At the end of the period there were 9 discarded bits and 12 still in fair usable condition. There had been 18 failures of the stud, called Series 13 attachment, but none of the drill rods or shanks had failed. Tests were continued during December 1947 with equally good results.

Conversion to Insert Bits

Following the satisfactory tests with the 25 bits it was decided early in January 1948 to change all operations at the Kearney mine to tungsten-carbide bits. More alloy steel was purchased made up with studs and 100 Carset bits were ordered. The

I-R drill sharpening machine was equipped to set studs in the steel on which the detachable Carset bits are screwed. The cost of this equipment was not excessive. An old furnace which had been used for heating the steel and tempering conventional bits was utilized for tempering inserted studs. Best results were obtained by capping the stud with an old bit, heating to cherry red, and cooling for proper temper. The present practice is to heat the stud and end of the steel slowly to cherry red and then cool slowly until it will barely scorch paper, then stand on end with stud up to draw temper of stud. This practice has reduced stud breakage.

Some of the steel was made up from carbon steel, both 1-in. quarter-octagon steel and 1¼-in. hollow-round steel; later the purchase of carbon steel was discontinued and alloy steel was procured for drill rods. With the 1¼-in. hollow-round carbon steel there had been some trouble with the steel breaking off back of the stud. Much longer life is realized from alloy steel, although, the 1-in., quarter-octagon carbon steel has been satisfactory for use with stopers.

Good Results Follow Disappointment

During January and February 1948 the failure of bits was somewhat excessive. It is thought that this was due to the miners getting used to using these bits in place of detachable bits and conventional steel. For a while there was a little disappointment in the use of the tungsten-carbide bits. When it was found that more drilling per minute was being realized, part of the disappointment was offset. As time went on and the miners became more familiar with the tungsten-carbide bits, the feet per bit increased so that for the first four months of 1949 the average feet drilled per bit is in excess of 300.

Since the introduction of tungsten-carbide rock drill bits, a series of useful reports have appeared in Mining Congress Journal on their application and the problems involved. These pages tell the story of the adoption of this new mining tool by a small mine, the results obtained, and the difficulties encountered.

At the Pewabic mine of the Peru Mining Co. where the ore is much harder to drill, detachable bits were not feasible and conventional steel was used. When tungsten-carbide bits were introduced 596 bits drilled 115,367 ft or an average of 194 ft per bit used.

Month	*Feet Drilled*	*New Bits*	*Feet Drilled Per Bit*
January, 1948	7,914	70	113
February, 1948	11,740	76	155
March, 1948	11,936	70	171
April, 1948	12,397	53	234
May, 1948	14,500	62	234
June, 1948	12,646	34	372
July, 1948	12,264	49	250
August, 1948	10,402	29	358
September, 1948	11,598	32	363
October, 1948	13,722	51	239
November, 1948	17,024	83	205
December, 1948	18,633	60	310
Year, 1948	154,776	669	230

Month	*Feet Drilled*	*New Bits*	*Feet Drilled Per Bit*
January, 1949	17,646	75	230
February, 1949	17,403	75	253
March, 1949	19,376	51	410
April, 1949	18,447	60	379
Four Months, 1949	72,872	261	306
Total	227,648 ft	930 bits	244 ft per bit

Drilling 1½-in. holes in a limestone face with insert bits

Bit Failure Causes

Most of the failures of the bits is due to an insert being crushed or dislodged and if an insert is dislodged, it may immediately cause the crushing of the other inserts in the bit, especially in very hard rock. Approximately 42 percent of the bits finally fail because of crushing or dislodged inserts after considerable wear. If but one insert is destroyed, the bit is kept in use. If two opposite inserts are destroyed, the bit can drill satisfactorily. If two adjacent inserts are destroyed, the bit is considered of no further use. The second greatest loss of bits is due to bits being lost in a hole or not returned for some unexplained reason. About 27 percent of the bits going into the mine are either lost or not returned. Many of these have been discarded by the miner because of the inserts being crushed or dislodged; a con-

One new and a series of used Carset bits. Although damaged, bits 5 and 6 may still be used

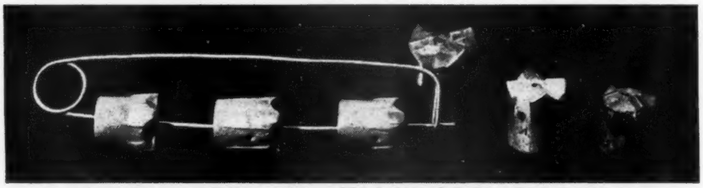
siderable number of these are lost because of being stuck in a hole. When this happens, it is customary to drill another hole about 4-6 in. from the first. By blasting this second hole the steel and bit may be found in the broken ore or muck. The third cause for failure is the failure of the skirt of the bit. This, no doubt, is due to fatigue and the bit rings off at the threads. At first, 21 percent of the bits failed from this cause but this cause of failure has decreased with the latest type bit to 15 percent. In addition, about 10 percent of the first bits failed because of worn out threads and this cause of failure has increased to 16 percent as the life of bits increased. In the average footage drilled per bit, all these failures are included so that the total number of feet drilled, divided by the total number of bits going into the mine, gives the average feet drilled per bit.

When the face of the inserts has become dull so that the cutting edge is approximately 1/16 in. wide, or the edge is rounded, the bit is considered too dull to drill and it is then ground on a silica wheel until the cutting edge is but 1/64 in. wide. The insert is not ground to a knife edge as this is believed to reduce the life of the bit. It takes five or ten minutes to grind a bit. On new Carset bits, the two sides of the cutting edge form a 90 deg angle; after grinding, this angle becomes much more obtuse. The first grinding is usually after the bit has drilled 50-100 ft and at intervals of 50-100 ft of additional drilling, the bit is resharpened. Some bits drill more than 400 ft and some fail before being sharpened.

New and used tungsten-carbide bits purchased during the first half of 1948 are shown in Fig. 1. No. 1 is a new 1½-in., Series 13, Carset bit. No. 2 shows this bit after it has drilled approximately 75 ft and has been sharpened by grinding on a silica wheel. No. 3 is a bit which has drilled between 100-200 ft and ground for the second time ready for more drilling. No. 4 shows a bit which has been re-ground twice and then used for additional footage. This bit has drilled well over 200 ft. No. 5 is a bit with one of the inserts gone. This bit is still serviceable. Both No. 5 and No. 6 have drilled more than 200 ft. No. 7 is a discarded bit with two adjacent inserts dislodged or crushed. No. 8 is a bit with skirt rung off.

Improved Bit Design

During the past year there have been some changes in the design of the Series 13, Carset bit. Three used bits on a bent wire "safety-pin" which the miners use to carry the bits are shown in Fig. 2. The bit to the left is the first design, the next is a buttressed bit and the third is the present design with increased depth of tungsten-carbide. Back of the "safety-pin" is a two-inch bit which has been used for holes up to 18 ft depth drilled with a wagon drill. To the right is a new Series 13 bit and a bit which has drilled more than 500 ft.



Several types of Carset bits. Third from left has deeper inserts

The gauge loss indicates to some extent how much drilling has been done. Bits lose about 0.015 in. in the first 50 ft of drilling due to the points being worn off. From this point on, the loss in gauge is slight. A great many of these bits are carefully measured and gauge loss varies from 0.014 in. to 0.046 in. when the bits fail. The maximum loss encountered was 0.068 in. and the average for a great many bits is 0.0245 in. when the bit failed. The hole diameter is sufficient in all work so that a new bit may be used to drill the last two feet of a hole following an old bit used to start the hole; however, it is customary for the miners to use the new bits in the first part of drilling a hole.

Important Savings Realized

Savings realized from using tungsten-carbide bits at the Kearney mine may be divided into several heads. The cost of bits per foot drilled is less than with detachable bits or conventional steel. Detachable bits, in the hardest rock, drill from 4-12 in. and in soft rock 2-3 ft, the average per use being 1½ ft. When the cost of detachable bits and three sharpenings is considered, the cost for four uses is approximately 18c per use or 12c per foot. For the tungsten-carbide bits, the cost is $12.00 per bit, in lots of 100, or 4c per foot on a basis of over 300 ft per bit. Probably the most important saving is in the more rapid drilling of the 1½-in. hole instead of starting with a 2¼-in. hole and finishing with 1½-in. hole using detachable bits or conventional steel. It would appear that drilling is done about twice as fast with the Carset bit. For some unexplained reason, it is often found that drilling is from three to four times as fast. With conventional steel or detachable bits in garnet and magnetite gangue, a speed is obtained of from 4-6 in. per minute. With the tungsten-carbide bits, 12-16 in. per minute is drilled. This, of course, does not mean that a miner can go in and drill two or three times as much in a shift because a considerable part of his time is taken up in preparation for setting up, tearing down, and getting ready to blast. It does mean the time consumed in drilling is cut to one-half or one-third so that when often in extremely hard ground he might fail to get his round in during the shift using conventional steel or detachable bits, by using tungsten-carbide bits it is rare that a miner fails to get his

Long feed in conjunction with insert bits increases full throttle head time in drilling 18-ft holes

round in and ready for blasting before the end of the shift.

Other savings accruing from the use of tungsten-carbide bits are reductions in machine repairs, the amount of air required to be compressed for drilling, and the amount of powder used. Inasmuch as the drill hole is approximately 1 9/16 in. from beginning to end, it will not hold as much powder as a hole started at 2¼ in. and bottoming at 1 9/16 in.; but since the powder is wanted at the bottom of the hole there is some savings with equal breakage of ore or waste.

Timken tungsten-carbide bits have been used at the Kearney mine and in limestone were found comparable to Carset bits. When drilling garnet the miners prefer the Carset bits.

Experience Indicates Change

Considerable trouble has been experienced with studs breaking and the threads stripping both in the bit and on the stud and because of this, some tungsten-carbide inserts were set directly into alloy drill steel. Some of these failed because the slots were not to exact size. Some drilled exceptionally well, but they were not as convenient to bring out to sharpen. Experience at the Kearney and Pewabic mines indicates that a larger stud, perhaps ⅞ in. instead of 13/16 in., would reduce the amount of stud breakage and thread stripping without increasing skirt breakage. This has been discussed with the manufacturers and it is hoped that tests with a larger stud with the 1½-in. bit may be made in the near future.

The miners take four bits on a safety pin when they go underground and bring them out when they finish their shift work. The bits are inspected, sharpened if necessary, and those bits which are not usable are replaced. At least once a week all steel is inspected and sent to the shop if not in good shape. If the stud shows much wear it is cut off and a new stud is driven. Careful inspection of the bits and stud attachments has materially increased the life of the bits. Threads of the bits are lubricated with hoisting rope compound.

Fred Woods and Joe Tompkinson of Ingersoll-Rand have provided great assistance in this work and the cooperation of J. W. Faust, general superintendent, and Mario Galassini, superintendent in charge of the Kearney mine is also deeply appreciated.

Joseph A. Holmes Awards

TWELVE medals of honor and 188 certificates of honor in recognition of outstanding contributions to safety in mines and plants of the mineral industry have been awarded by James Boyd, director of the Bureau of Mines and president of the Joseph A. Holmes Safety Association.

In mining, six of the medals of honor were awarded for acts in which men risked their lives together to save others. Medals were authorized for Aubin Higgins and William Hill, both of Earlington, Ky., and Edward McGaw and Lonnie McGrew, both of Wheatcroft, Ky., for their rescue of Ilvey Dunning in the East Diamond mine of the West Kentucky Coal Co. at Madisonville, Ky., in March 1948. Raymond D. McCause and Vestor Monk were awarded medals for exceptional courage in rescuing Charles Cheatum at the Climax Molybdenum Co. mine at Climax, Colo., in October 1948. Alonzo Payne of the West Virginia Coal and Coke Corp. was also a medal of honor and diploma recipient.

Thirty-three men received certificates of honor for long-time service in promoting health and safety in mining. Certificates of honor for notable achievements in safety were awarded to 64 coal mines and mining companies, to 42 metal mines and mining companies, and to 5 nonmetal mines and companies.

Mining Dipping Seams in Alabama

Undercutting Machines and Handloaded Conveyors Successfully Operate in Steeply Pitching Coal

By I. W. MILLER
General Superintendent
Black Diamond Coal Mining Co.

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This extract of a more detailed paper which will appear in full in the 1949 Coal Mine Modernization Year Book is presented here because of the growing interest in production methods used to mine economically in steeply pitching coal seams.

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DIPPING coal seams in Alabama occur throughout the whole extent of the Cahaba field and along the southeast boundary of the Warrior field. The Cahaba field, long and narrow, approximately 80 miles in length and 8 to 10 miles in width, is underlaid throughout by dipping beds, the dips steeper on the outcrop usually 25 to 30 deg, varying from and decreasing to practically flat lying where followed down the dip to the east. Bordering the boundary fault on the east side of the field the strata are upturned to vertical or even an overturned position.

The field is divided, by cross folds, into several separate basins known locally as Henry Ellen, Acton, Helena, Blocton, etc., and from a structural viewpoint there are such wide variations in strike and dip, and other adverse conditions due to folding and faulting, that any Cahaba operation usually encounters a wide variety of mining problems connected with coal recovery from these dipping beds. There is only a comparatively small percentage of coal recovery from flat lying coal which lies miles from the outcrop and carries extremely heavy overburden, and much of it is beyond the economic range of present slope operations.

Early Mining in Alabama

The mining or dipping seams in the Cahaba field started before the Civil War. These early operations consisted of small drift mines opened at strategic locations made possible by stream erosion which exposed the outcrop further down the dip and at a lower level than the main outcrop on higher ground. These drifts were driven along the strike with sufficient grade to afford drainage, and were ventilated by furnaces. Angular rooms were turned uphill and driven on such a grade that the small cars could be trammed to the faces either by hand pushing or mule power. Obviously, the area of coal available for these drift operations was limited, and also, on account of the seams being so near the outcrop, considerable weathering had taken place, and the coals were usually stained and low in Btu.

Following these drift operations, short slopes were often opened at locations where the dip was light, and sometimes driven angling across the dip to further reduce the grade. Drainage water was either siphoned, hauled in cars to the surface, or removed with hand-operated pumps. Short headings were turned and developed in the same manner as the drift operations. The coal was gathered and hauled up the slopes by mule or horse power. If the grade up the slope was too great to pull the cars direct, ropes and pulleys were used, or rope and whim. This early mining was, of course, primitive and the total tonnage mined was small, but it marked the beginning of larger scale operations in dipping seams of both fields.

With the use of steam hoists and steam pumps many of the shallow slopes developed earlier were extended and developed into much larger scale operations. Later, electric power became available and practically all steam driven equipment was converted to electric motor driven. This marked the beginning of more comprehensive plans and methods of working the seams of both lighter and steeper dips.

Introduction of Machines

Following the period of conversion from steam to electric power, several types of heavy and unwieldy conveyors became available and were tried out at considerable expense and sometimes with disastrous results. After the manufacturers began making lighter and more flexible types, considerable progress was made in mining dipping seams resulting in greater recovery, better quality, and lower mining costs. Up to this time, all coal produced in both fields was shot and mined on the solid where the dip was low and was loaded at the face direct by hand into mine cars.

Where the dip was steep enough to allow the coal to slide by gravity, which from practical experience must be above 35 percent, the coal was commonly moved down the dip from the face to the entry in metal-lined chutes. The introduction of conveyors with mining machines made possible the economical recovery of lower dipping coal where gravity chutes were unworkable and materially improved the quality of the coal and made possible more concentrated methods of mining.

In the Cahaba field, the Boothton mines of Southern Coal & Coke Co. with advancing semi-longwall method, were the first to begin undercutting dipping coal, using chain conveyors for conveying the coal from the working faces. This was during 1921. Later several other mines with varied methods of wide-face mining began undercutting the coal combined with the use of chain conveyors. During 1938 the Blocton No. 9 mine of Black

Diamond Coal Mining Co. with ordinary room and pillar method, was the first mine to adopt the use of shaker conveyors in a dipping seam in Alabama combined with mining machines undercutting the coal in rooms driven up the dip.

During 1945 the Black Diamond Coal Mining Co. installed chain and flight conveyors in the Blue Creek basin at both its Blue Creek and Black Diamond mines, and are successfully undercutting the coal in rooms driven up the dip which ranges up to 40 percent. These operations will be described more in detail.

Longwall Development

This illustration, in Fig. 1, was taken from one of the four Boothton mines of the Southern Coal and Coke Co. in its earlier stages which worked this semi-longwall plan on two closely associated seams, viz., the Gholson and Clark, the thickness of the intervening strata averaging from 40-50 ft. The dip ranges from 26 percent at the outcrop to 10 percent at the faces of the present workings which are now some 7000 ft from the outcrop. The Gholson, or upper seam, averages about 34 in. in thickness of clean coal with good roof, but is somewhat erratic in thickness. The Clark seam, below, averages about 50 in. of total thickness with a 4-10-in. parting near the top part. The roof conditions are fair to poor.

The Southern Coal and Coke Co. which opened and operated these mines for some 28 years, was the pioneer of this system which was started some 27 years ago. Up to the present time it has been successful from an economic standpoint as well as from the standpoint of percentage of recovery. Except for barrier pillars along the main slopes, barrier pillars between the mines, and a few barren areas, the extraction has been around 95 percent, which far exceeds any other plan yet tried on dipping seams in Alabama. A total of approximately 900 acres have been mined out on these two seams with this unusual high recovery and with an overburden ranging up to 1200 ft. These properties were taken over by Boothton Coal Mining Co. in 1944.

As will be noted, the walls are worked on the advance rather than on the retreat, which obviously has developed problems such as maintaining the entry haulageways and ventilation. However, maintaining and preserving the entry haulageways has not proven to be as expensive as might appear due to the fact that a maximum of four producing entries, two on either side of the slope, are usually worked at one time. When subsidence begins on the walls, the solid coal and thin pillar below, as well as the pack walls along the upper side (20-30 ft thick) of the entry, tends to cushion the roof action so that the failure, or breakage, of the roof occurs some distance above the haulageway. However, there is some subsidence along the entry haulageways, but this is anticipated and extra height is taken by brushing the roof in the Gholson seam, and by lifting the bottom in the Clark seam where there is an 8-15-in. bench of coal some 12 in. below the main seam. In working this plan on two seams of coal so close together simultaneously, it is necessary that the workings in the upper seam be kept well in advance of those in the lower, for obvious reasons.

Ventilation has presented the more serious problem in this plan. The method of ventilating the wall faces is by necessity two main splits, one on either side of the main slope, which is the main intake. This means one continuous current for each side of the mine which must be passed from developing entries below to the two walls above. The air returns through old worked-out walls to the fan. As these mines give off some methane, a close and frequent check must be made of the gas content as it reaches the furthest outby working wall.

Procedure and Equipment

Cross, or wall entries, are turned on intervals of from 300-400 ft and each is driven on a gradient of 2½-3 percent for an average distance of about 2200 ft. After the entry has been driven past the sidetrack and slope barrier pillar, a narrow room (or pair of rooms) is driven straight up the dip to the entry above with a chain conveyor. The outby rib of the room is then undercut with an a-c, longwall-type machine and advanced. This wall extends from the lower rib of the advancing entry to within 15 or 20 ft of the entry above, making the total length of the wall from 300-400 ft. After the wall has extended several hundred feet, and pressure from subsidence begins to show along the face, little if any blasting of the coal is necessary. Thus a large percentage of domestic sizes are produced.

The conveyors used along the face are locally made, and are 12-14 in. deep. The coal is moved by a large link chain without flights. The reason for such a large panline is that it affords considerable storage which is used between trips. Coal is loaded on the conveyor by hand, and dis-

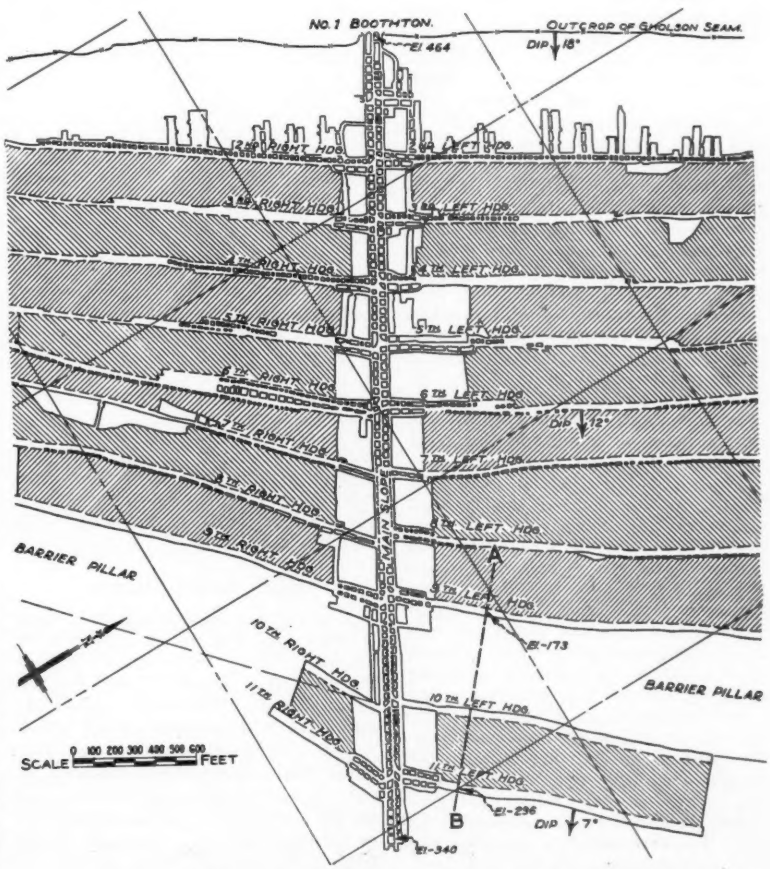

Fig. 1. Semi-longwall method of mining pitching seam in Cahaba field

charges into a second chain and flight conveyor located alongside the upper side of the entry track and extending outby a sufficient distance to provide storage for trips of some 15 or 20 cars. The trips of cars are handled by a small hoist located on the entry some distance outby the face and with a rope around a sheave wheel in the center of the track at face of entry. This serves as a car spotter and trams the loaded trips by gravity to the slope sidetrack. The use of this second conveyor not only provides storage space for a trip of cars, but also facilitates the driving and grading of the heading which is undercut and advanced along with the wall.

A normal crew used on a 400-ft wall consists of the following men: *Day Shift*—1 foreman, 1 machine runner, 1 machine scraper, 1 driller and shot fireman, 2 timber men, 10 loaders, 1 hoist man, and 1 car trimmer: *Evening Shift*—2 rockmen and 4 service men; total crew per day 24 men. With a 400-ft face and 24 men, the average production is 130 to 150 tons, or an average of about 5½ to 6¼ tons per man.

Blocton Basin—Cahaba Field

The small scale map in Fig. 2 shows the topography of this basin in which is located the Black Diamond Coal Mining Co.'s No. 8 mine. This is now being mined as shown in Fig. 3. Headings are turned off the main slope haulageway at intervals of 425 ft, and driven straight on a gradient of 2½-5 percent for distances up to 4500 ft. Small electric hoists are installed in each entry and are used as car spotters in loading the cars, for lowering the trips by gravity to the slope sidetrack, and hoisting the empties from sidetrack to loading point.

Rooms are turned on 80-ft centers and driven 50 ft wide. With a shaker conveyor in each room, three to four rooms are driven abreast. These discharge into a chain and flight mother conveyor located either in the air course above or alongside the track on entry. This mother conveyor discharges into a loading conveyor located in the neck of the furthest outby working room. At this common loading point 15 car trips are loaded. The entry and air course above are driven with a shaker conveyor in each. The entry conveyor discharges through a cross cut into the air course conveyor which delivers the coal into a chain and flight mother conveyor serving the room conveyors.

Entries are brushed, 6 ft high above the rail, by a separate two man crew. The sections brushed are between the last inby working room and the crosscut where entry conveyor goes through crosscut to air course, so that with this arrangement, brushing can be done simultaneously with coal loading at the entry face. The entries and air courses are usually kept some 300-500 ft ahead of the last working room.

The coal is undercut in these rooms by both shortwall and longwall types of machines and loaded by hand into the face conveyor operated from a Bell crank at the end of the main panline. On account of the rather tender roof, timbers are set on a maximum 3-ft center in all rooms. A coal cutting machine is used in each working face, and each face is maintained on a complete cycle. All power in this mine is a-c current. The total recovery of entry work is from 62-65 percent.

A complete crew per shift for a multiple setup of three rooms, entry and air course, is as follows: 4 men in entry and air course, 2 rock men, 12 men in rooms, 1 car trimmer, 1 hoist man and 1 section foreman, making a total crew of 21 men. The total tonnage produced is from 140-160 tons per shift, or 6.7 tons to 7.6 tons per man.

Blue Creek Basin

A cross section through the basin is shown in Fig. 4 at the location marked "A"—"B," which runs through the Black Diamond and Johns mines. This section shows the anticlinal and synclinal folds which formed this double basin in the Blue Creek seam and gives some idea of the changing dips encountered and the adverse haulage problems involved in hauling the coal. The dip varies from a maximum of 40 percent at the outcrop to flat lying along the trough of the basin. Practically every method known at the time for working dipping coal was used in these mines.

Black Diamond Mine

A new mine opened in 1944 on the south limb of the basin, was the first operation in Alabama on dipping coal to use a maximum of mechanical equipment. The coal bed at this point shows a medium dip varying from 25 percent on the outcrop to flat lying in the bottom of the basin and the detailed structure of the area was carefully determined in advance of operations. The equipment and mining methods used were then designed to best meet these structural conditions. The mine results up to date have fully justified this original plan of operation which is still in effect. (See Fig. 5) The Blue Creek seam at No. 1 slope, Black Diamond mine, shows possibly its best condition in the basin with an average thickness of 10 ft, and a minimum thickness of partings.

The mechanical equipment and mining methods used here are similar to those ordinarily used on flat-lying coal but are new in Alabama on such steep dipping beds. Rooms are driven directly up the pitch, undercutting the coal and using chain flight conveyors to move the coal from the face to mine cars on the heading. All mining machines and conveyor units use d-c current which is also available for motor haulage in the bottom of the basin. The coal cars on the headings are handled by small entry hoists

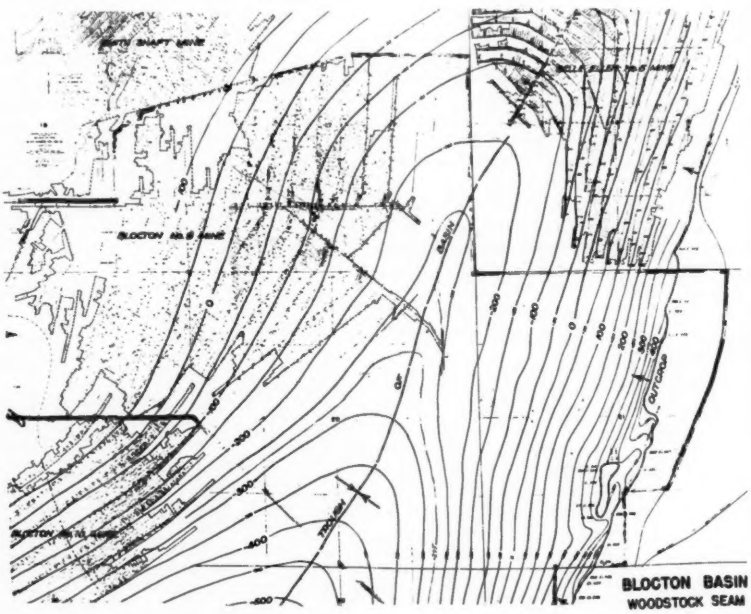

Fig. 2. Blockton basin—Woodstock seam

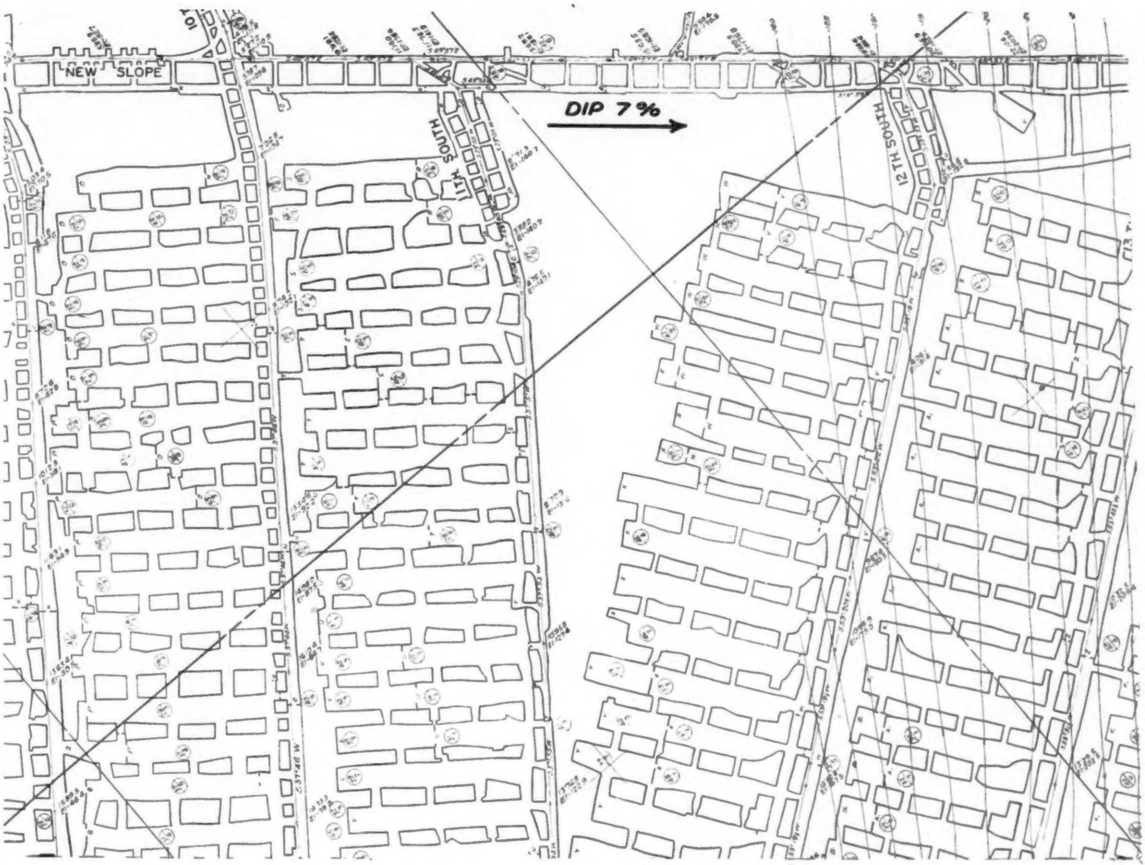

Fig. 3. Blockton No. 9 mine was developed by hand loading on shaking conveyors—coal delivered into cars on entry

between the slope sidetrack and the loading point.

The main slope is driven approximately down the dip, and cross entries turned on about 400 ft intervals and driven on a gradient of 2-3 percent. The entries were first driven to their respective limits and the furthest outby rooms turned first, thus retreating with the rooms which are turned on 80 ft intervals and driven 40 ft wide.

Both entries and rooms are driven with chain and flight conveyors. Three rooms are usually turned abreast with room conveyor along one rib of each room and a conveyor located either in the air course above the entry, or along the track on the entry where all the coal discharges at a common loading point. A small entry hoist located on the entry outby the first room worked, spots the trips of four-ton steel cars at the loading point and trams the loaded trip by gravity to the slope side-track.

A team of 12 men at the faces, 1 car trimmer, 1 hoisting engineer and a foreman comprise the crew for one of these entry setups in rooms. The average tons per shift for this 15 man crew is from 120-150 tons, or an average of 8-10 tons per man.

The coal in rooms driven up the dip is undercut with machines, keeping the loading and cutting on a cycle in each room. The power used for all underground equipment except the main pumps is d-c current furnished by a 200 kw Westinghouse motor-generator set located on the surface between the Nos. 1 and 2 slopes. The extraction made on the first operation is around 50 percent. Robbing operations will not begin

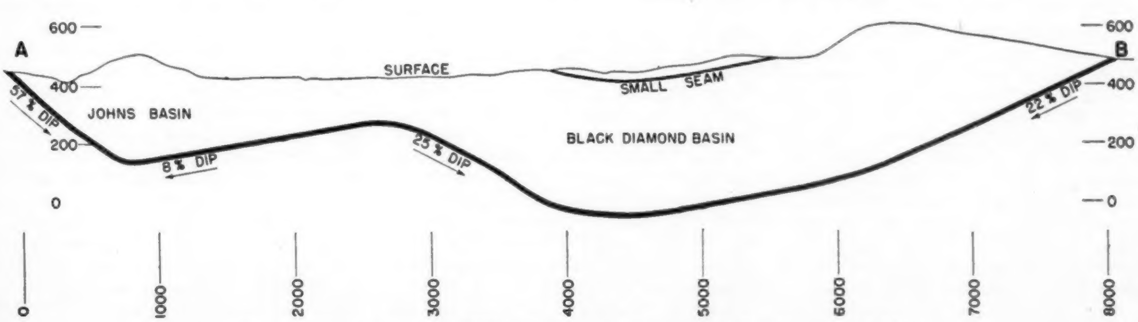

Fig. 4. Cross section A-B of Blue Creek seam show anticlinal and synclinal folds

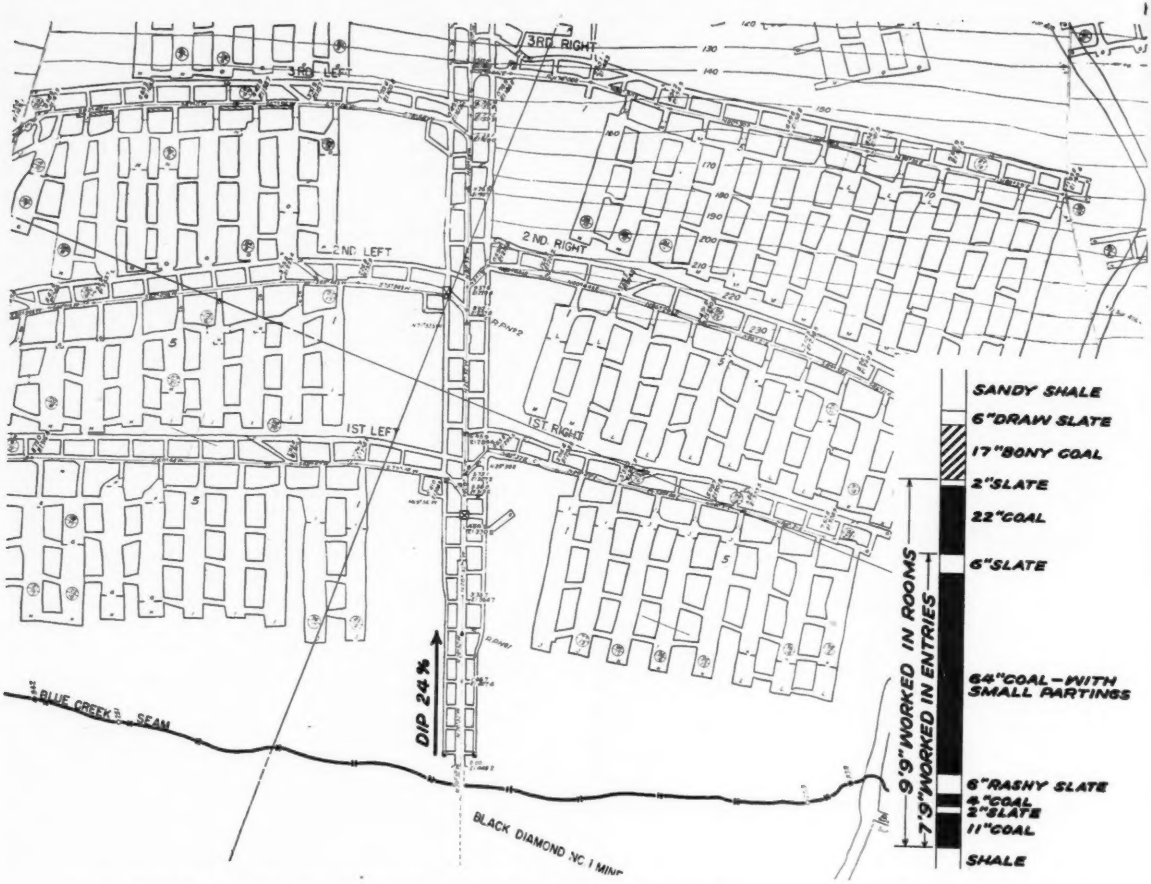

Fig. 5. Black diamond mine was developed by hand loading on chain and flight conveyors—coal delivered into cars on entry

until all room work is completed. With these short entries and good roof, 80-90 percent of the pillar coal will be extracted.

A favorable feature of this operation on an unusually thick seam is that the top bench of coal (22-26 in.) is left in place for a roof in all workings except the rooms, where the full seam section is mined. This top bench affords an ideal roof and practically no timbering is necessary where it is left in place. It will be recovered along with the robbing operations.

Conclusion

The future for increased mechanical mining in the dipping seams of Alabama is not promising. With the exhaustion of present mines in the Cahaba field, which primarily produces domestic coal, the possibility of important developments in the near future are doubtful in view of the increasing competition of oil and gas and our gradually increasing production costs, especially high on dipping and often disturbed beds such as exist in this field. A tremendous tonnage of high grade coal in thinner seams still remains unmined and there is a distinct possibility that improved mechanical mining methods will be the decisive factor in the future that will make this coal competitive with the better situated flat lying coal of the Warrior field.

Safety Trophies Awarded

"SENTINELS OF SAFETY" trophies for outstanding safety achievement in 1948 were awarded leaders in six classes of mineral operations. In this 24th annual National Safety Competition, held under the auspices of the U. S. Bureau of Mines, the "Sentinel of Safety" trophies, donated by *The Explosives Engineer*, are held by the winning company for one year. Each employe of the six companies receiving the awards will be given a certificate of achievement in safety.

Certificates were also awarded to mines and quarries with above average safety performances. Certificates, as well as the trophy awards, are based on the tabulation of injury records. Perfect safety records throughout the year were reported by 113 of the 507 mines and quarries enrolled in 1948. These 113 mines and quarries operated a total of 10,765,443 man hours without a disabling injury. Statistics for the 1948 contest show that mines and quarries competing have safety records much better than the industry as a whole.

Trophy winners of the various classifications are as follows: Underground anthracite mines—The Hunter Tunnel mine of the Philadelphia and Reading Coal and Iron Co., Ashland, Pa.; underground bituminous coal mines—Reliance No. 7 coal mine of the Union Pacific Coal Co., Reliance, Wyo.; underground metal mines—Fraser underground iron-ore mine of the Oliver Iron Mining Co., Fraser, Minn.; underground nonmetal mines—Ironton cement rock mine of the Alpha Portland Cement Co., Ironton, Ohio; open-pit mines—Spruce iron-ore mine of the Oliver Iron Mining Co., Eveleth, Minn.; stone quarries—Hanover limestone quarry of the Bethlehem Steel Co., Hanover, Pa.

A southern kaolin pit and washing plant

Kaolin Mining In the South

Prospecting Techniques and Selective Mining Methods Geared to Exacting Market Specifications

By PAUL M. TYLER
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Washington, D. C.

DESPITE the squeeze between rapidly mounting wage rates and relatively inflexible price ceilings on its products the mining of kaolin or china clay has become one of the fastest growing mineral industries of the United States. Largely as a result of their being able to produce better and better products with less and less labor, domestic miners trebled their output during and shortly after the first World War, trebled it again in 1941, and since the recent war boosted their former records by over 50 percent.

Although residual clays are mined in North Carolina and good white clays are produced also in other states the main sources of high-grade paper, pottery, and rubber clays in this country are in the southeastern states. These naturally-concentrated deposits contain what is believed to be the finest crude white kaolin in the world. Georgia recently has produced over 70 percent of the total domestic output, South Carolina ordinarily contributes almost 20 percent, and all the other producing states together rarely furnish as much as 10 percent. Mines are deeper and consumers' specifications are progressively more exacting but the sharp advances in all the factors that influence costs have been offset by better technology.

Clay Found Over Wide Area

The principal deposits lie in the Coastal Plain mainly in the Cretaceous beds that outcrop near the Fall line. The most productive belt lies in the Tuscaloosa formation (Upper Cretaceous) which stretches southwesterly across South Carolina from Cheraw to Aiken and then through Georgia past Augusta and Macon into Alabama. Deposits of white sedimentary clays are found elsewhere in the Coastal Plain but are not worked extensively in these states except for the highly-plastic naturally sandy Tertiary (Eocene) kaolins in north central Florida. Bauxite, associated with much white clay, is mined near the contact of the Wilcox-Midway formations (Eocene) in Georgia and Alabama and natural bleaching clays are derived mostly from the western section of Florida and nearby Georgia. The important ball clays of western Kentucky and Tennessee are partly Cretaceous but mostly Tertiary. Some of the best New Jersey clays, however, were probably deposited about the same time as the Georgia and South Carolina kaolins.

High-grade clays are found in horizons that consist principally of highly silicious sands containing variable amounts of sericitic mica. The clay was originally present as vast residual deposits on the Piedmont Plateau in pre-Cretaceous times. Now it occurs in quite restricted areas, representing zones of quiet water where the clay could settle slowly without being invaded by suspended sands. Suitable conditions were afforded in fresh water lagoons or perhaps occasionally by reef-locked or undulating sand flats off shore. Current lines in these ancient rivers and coastal waters are represented by gritty coarse-grained clays and arkose interstratified with the sands.

Minable clay deposits are generally lens-shaped but some times they cut off abruptly instead of wedging out at the boundary. Many of them are 50 acres or more in extent and the thickness varies up to 40 ft or more. Occasionally two lenses may be close enough together to be worked from the same pit but they do not overlap vertically. At any given point the clay-bearing horizon is always at a definite elevation above sea level. It follows that prospecting below the

floor of a worked-out pit is fruitless unless the lower part of the clay was deliberately left unmined. Geologic markers that may help to identify the clay-bearing horizon or overlying strata include notable differences in texture, color, or mica content of the sands. Unfortunately, however, the sequence of such changes is likely to vary in different localities and even in nearby mines. Although the same characteristics may be repeated at different properties, they are discontinuous and unpredictable. When properly recorded in prospect drilling they provide the stripping and mining crews with advance information of considerable value.

Quality of Clay Variable

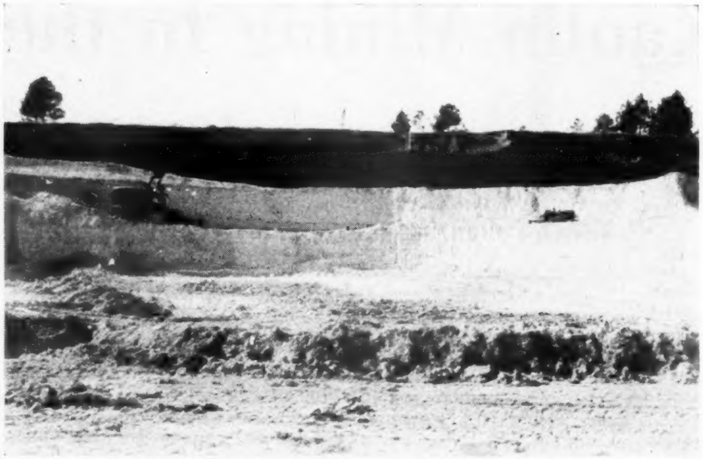
Few deposits are uniform. Even though the color remains white, there may be changes in texture and grit content so that a certain amount of selective mining is usually necessary and mixing and blending is the rule at virtually all mines. All colors can be observed except true green or yellow but the commonest impure kaolins range from pinkish to magenta to red and grade into strong purple hues. Unless the discoloration is very slight the kaolins are valueless except for local use in making brick or other heavy clay products. Yellow to brownish iron stains are readily eliminated by chemical bleach at wet-washing plants but other colorations are not commercially removable. Blackish clays are likely to turn grey to grey-brown when dry. Occasionally one finds clays that are rather badly discolored by an organic red or brown stain which disappears on firing or even on drying; such clays may be acceptable to the pottery or rubber trade but are not ordinarily usable in paper or paint.

According to their main uses, kaolins may be classified into paper clays, potting clays, rubber clays, and refractory kaolins. Clays used for numerous other purposes—including paints, chemicals, and miscellaneous fillers—can usually be classified under one of the foregoing groups. The term "sagger clay," for example, is indefinite since it covers not only various types of kaolins but also ball clays and in fact any clay that may be used in making saggers or similar containers for pottery and other ceramic wares.

Normally the paper industry takes over 50 percent of the kaolin consumed in this country, the pottery industry 15 to 25 percent, the rubber industry and refractory uses each about 10 percent, and miscellaneous uses usually over 10 percent. All of the South Carolina operations are aimed at present at the production of rubber clays as their main product and this State is the main source of this type of clay. Several Georgia operations are confined to the production of rather low-priced refractory kaolins with perhaps a carload now and then of medium-priced potting clay. The largest Georgia operations, however, are geared to the production of paper-coating clays as the cream of their crop and process the remainder of their tonnage for paper filler and other uses. Since the amount of clay that can be processed for good coating clay is variable and usually represents only a minor fraction of any deposit, kaolin mining tends to be highly selective and often seems quite wasteful. Even companies having proper processing equipment and "know-how" leave a good deal of apparently good clay in the pit and occasionally run to waste a sizable batch of material in the treatment plant. Better treatment processes tend to minimize such waste but balancing of markets against the whims of Nature is often the dominant factor. Although the color and general appearance of the clay bank may be the same, variations in particle size, viscosity, and other characteristics may develop in a seemingly uniform deposit within a few feet vertically or horizontally. At some mines it is necessary to post a chemist in the pit to make laboratory tests just ahead of the digging to determine whether the clay should be sent to the plant or consigned to the dump.

Prospect Drilling Outlines Deposits

Most mines were started from outcrops or on showings discovered accidentally by digging post holes or wells. Some mines are pits in a relatively flat terrain but more often they are opened on a sidehill, the ratio of overburden to clay becoming rapidly greater as the pit grows larger. Prospect drilling is employed more and more to delineate and evaluate deposits but prospecting under deep cover has never been necessary in South Carolina and is rather uncommon in Georgia. At many mines hand auger holes are put down back of the



Mining white clay in Barden pit of Huber Clay Co.

Hand cleaning top of stripped clay just before mining. Albion Kaolin Co.

face in order to sample the stripped clay ahead of mining. In such cases the purpose of preliminary exploration is merely to determine whether the deposit, or selected portions of it, should be stripped. Recently, however, as market specifications for clays, and particularly for paper-coating clays, have become so exacting, prospecting techniques have advanced accordingly.

Owing to the nature of the overlying sands and of the clay itself, any of the prospecting methods usually employed for soft ground are applicable. Hand augers are still used and when drilling is incidental to other operations may be preferable since the prospecting crew can be assigned to other work around the mine or plant. When the number of holes is large, however, the usual type of equipment is now the seismograph or similar rotary core type drill. Although there is some complaint regarding the available types of core-barrels, the manipulation of this drill affords no unusual features. Costs are estimated at 75¢ per foot of hole as against perhaps $1 for hand auger drilling. Power augers have been employed occasionally for preliminary testing but not where quantitative data are sought.

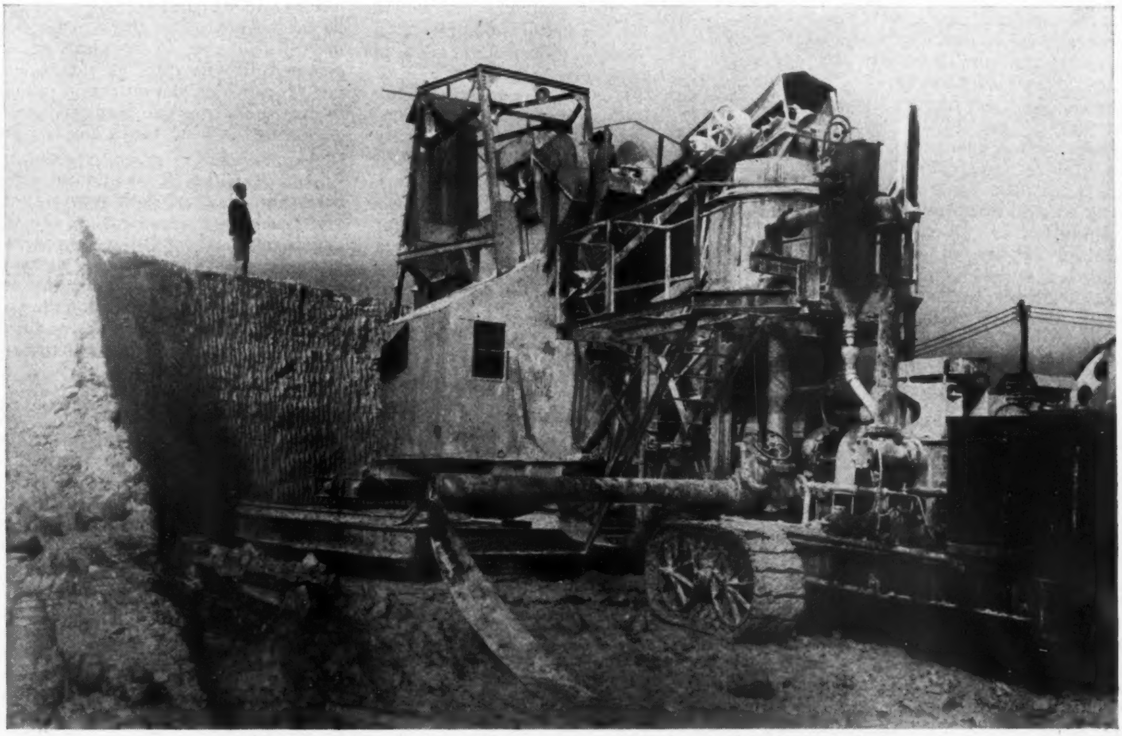
After optioning a raw prospect it is customary to drill a few widely spaced wildcat holes. If these are promising a block of ground is selected and holes drilled on a 400-ft grid. As the general outline of the deposit is developed holes are spaced 200 ft apart and before stripping is begun it is customary to cover the area with holes not over 100 ft apart. Core samples from the clay bed are examined carefully and the section that appears minable is sent to the laboratory for necessary tests. Occasionally, however, the entire core in the clay bed is sampled at intervals of 2-5 ft intervals.

Working up the drilling and sampling records, mapping the formation, and evaluating the deposit are far more complicated in the case of high-grade clay deposits than corresponding operations in metal mine exploration. Not only is it necessary to note the characteristics of overburden so as to inform the stripping crew as to elevations above the clay horizon but the clay body itself must be divided up into relatively small segments according to whether the minable thickness is suitable for processing into paper-coating, paper-filler, potting clay, etc. Typical maps and sections employ all the colors of the rainbow and recapitulation of tonnage of each class of commercial clay available must anticipate the probable sequence of mining operations and the concurrent treatment and marketing problems.

Stripping

In Georgia where the workable thickness of clay averages less than 20 ft it is considered profitable under present conditions to strip as much as 100 ft of overburden and in the case of one or more exceptionally high-grade deposits over 125 ft of overburden may be removed. The average stripping ratio at present is probably of the order of 3 ft of overburden to 1 ft of minable clay.

Virtually every type of earth-moving equipment has been employed for stripping. Outmoded equipment and methods are still employed and in recent years even the choice of new equipment has often been governed by delivery dates or other factors than the best possible appraisal of economical performance. It is generally recognized, however, that stripping is primarily an earth-moving job and a relatively simple one in this area because of the nature of the overlying waste. This waste is largely sand, almost entirely free from boulders, or even coarse gravel, and unconsolidated so that blasting is rarely required to loosen it up. Although spoil generally has to be moved several hundreds of yards, often uphill, and seldom can be back-filled into the pit, stripping costs generally range be-



Continuous clay miner and blunger prepares clay for pipeline transportation

tween 8½ and 20¢ per cu yd averaging perhaps 13¢ on jobs involving the movement of a million tons or more. On smaller jobs local contractors generally charge as much as 25¢ per cu yd.

In South Carolina and at several of the smaller mines in Georgia power shovels and five-ton trucks are used for both stripping and mining. After handling overburden the truck beds are washed from a high-pressure hose before handling white clay again. Full-revolving Diesel-powered shovels are standard and bucket capacities range from ¾ to 1¼ cu yd. The clay digs easily with the dipper and the banks stand well for lifts up to as much as 20-30 ft. Planks are needed under the shovel only where the clay or sand has stood under water for some time. Pits are generally self-draining and trucks keep running except on the wettest days. Removal of the last 1 or 2 ft of overburden is still done at some mines by hand but can usually be accomplished with a bulldozer.

At the largest mines excavation is commonly by means of draglines and the material is hauled away in Euclid drop-bottom trucks. "Snow-loaders" (elevating graders) are sometimes used instead of draglines and are said to be cheaper. One company installed a long belt conveyor for moving the dirt but sold it later. The present trend, however, is toward wider use of tractor - scrapers or "pan - loaders" (e.g. Carryalls or Tournapulls). On similar service in Florida these machines move sand at a cost of 10 to 13¢ a cu yd and similar results are probably obtainable elsewhere. Probably the cheapest dirt-moving in Georgia is at one of the fullers' earth mines where pan loaders are used to excavate the upper third of the bank, the remainder being dug and cast by long-boomed draglines behind the clay excavators at a cost estimated at around 5¢ per cu yd. Backfilling, however, is seldom practicable at the kaolin mines. In South Carolina it is often necessary to leave a large tonnage of clay at the bottom of the pit which may be mined later when or if suitable wet treatment plants are installed. Elsewhere the configuration of deposits may be too irregular.

Only a few years ago virtually all the clay was mined by hand as this afforded the maximum opportunity for selective mining. At present most of the clay is dug with dipper-stick shovels although one finds an occasional drag-line operation. A track-mounted shale planer was employed at one mine some years ago but was shipped away when this mine was closed. The latest innovation is a specially designed planer mounted on caterpillar treads along with a blunger so as to form a continuous mining unit.

Pipe Lines Replace Trucks

Since treatment plants are generally situated several miles from the mines, haulage is a considerable item of expense. A typical contract rate is $2 a short ton of wet clay for a 13-mile haul and it is doubtful whether many operations spend less than $1 per ton for transporting their clay from the mine to treatment plant and/or railroad. Narrow-gauge railroads with steam or Diesel locomotives were formerly employed but have been abandoned by all but one company. After experimenting with larger and larger trucks two Georgia companies have resorted to pipe line transportation which is said to be far more economical.

Hydraulically-mined clay has been transported for many years in the form of slip by open flumes in North Carolina and in pipe-lines in Florida and other minerals, notably phosphate rock, have also been pumped over long distances. The novelty in the case of Georgia clay handling is the high density of the fluid and the installation of a blunger at the mine for dispersing the clay and of classifiers, sand boxes, and/or screens for removing most of the grit. Clay is delivered to a central point by trucks or mine cars, crushed, and fed to the blunger along with measured quantities of water and necessary chemicals. Georgia kaolin as mined is usually slightly acid but is neutralized to facilitate its conversion into slip and suitable dispersants are commonly added to keep the clay in suspension. Even in Florida where the ratio of sand to clay may exceed 5 to 1 erosion of the pipe is negligible and Georgia clay slips are virtually non-abrasive since the grit content is reduced promptly to only a fraction of one percent of the dry solids content.

As pioneered by Edgar Brothers Co., the pipe-line slurry carries about 20 percent total solids but the Georgia Kaolin Co. pumps material averaging around 40 percent clay (sp gr 1.3). For those unfamiliar with clay slips, it may be stated that paper makers often work with slips carrying 60 percent solids and that clay slips shipped in tank cars carry 70 to 72 percent by weight (49 to 50 percent by volume). The specific gravity of the latter material is 1.75 yet it flows readily and shows no settling or flocculation after many days. As an extra precaution, however, the long pipe lines from the mines are designed so that they can be drained whenever there is a shut down of more than a few hours.

Novel Continuous Mining and Blunging Unit

What seems to be the last word in modern kaolin mining is the continuous mining machine designed and constructed by S. C. Lyons and associates of the Georgia Kaolin Co. This unit comprises a modified shale planer combined with a blunger. The combination is mounted on four caterpillar treads, two of which are power-driven. Instead of advancing parallel to the face this machine rotates slowly from side to side over a maximum arc of 180 deg and cuts a 42-ft swath straight ahead. The clay is chopped out by a continuous chain of cutters driven by a 50 hp electric motor and resembling a chain coal cutter operating in a vertical plane. The crowd on the machine is automatic and electronic controls regulate the swing so that the total cutting time at the center of the swath is greater than it is along the sides. Where the cutting is more or less tangent to the circumference of swing the amount of clay that has to be removed is obviously less per foot of net advance than it is in the center. The clay cuttings are of suitable size to be elevated and dropped directly into the vortex blunger from which the slurry is pumped to the sand removal plant whence it goes into the head tanks for the pipe line.

This machine, it should be noted, takes the place of both power shovel and trucks and also crushes the clay and blunges it, yet it can be operated by only two men. Including some more or less indirect labor, the output commonly averages eight tons per man-hour. Under favorable conditions it can handle as much as 30 tons of dry clay per hour.

Safe Blasting

A NEW safety film entitled "Blasting Safely in Mines" is now available. It was produced by the mining section of the National Safety Council with the assistance of the Anaconda Copper Mining Co. The scope of the film is limited to practices in blasting with fuse.

The film is a silent 35-mm slide film consisting of 52 pictures which emphasize safe practices in handling dynamite at the magazine, in making primers, loading, and lighting, and precautions to be taken after lighting.

With the film is a mimeographed discussion guide which assists the person in charge of showing the film. The guide includes comments for each picture. The price of the film is $10 to members of the National Safety Council and $20 to non-members. Inquiries should be addressed to Mining Section, National Safety Council, 20 N. Wacker Drive, Chicago 6, Ill.

Mill Measurement and Control

How Several Problems of Recording Essential Milling Data Were Solved

By C. M. MARQUARDT
Electronic Engineer
Combined Metals Reduction Co.

ONE OF the most striking features of our civilization has been man's ability to utilize and control forces for performing useful tasks far beyond the capabilities of his own strength. Automatic control is not new for in "The Arabian Nights" we find "Aladdin had no sooner rubbed the lamp, than in an instant a genie of gigantic size appeared before him and said in a voice like thunder, 'What wouldst thou have? I am ready to obey thee as thy slave . . .'." Obviously this is one of the first examples of a servo-mechanism. However, when compared to the present-day metallurgist searching for the automatic control for the modern ore dressing plant Aladdin and his genie were "pikers." Attempts to apply pH measurement to flotation processes are not new. In the early days titration with normal solutions was used. With the development of the electronic portable pH meters attempts were made to apply these instruments and in many plants they are still used. A later development was the automatic pH meter which could be attached to a recorder.

At the Combined Metals Reduction Co. as many as 14 different ores are treated on a custom basis. Management is continually faced with the problems that come with numerous ore changes. For some time the pH was measured in several places in the circuit using portable pH meters. It soon became obvious that automatic measurement and recording was desirable.

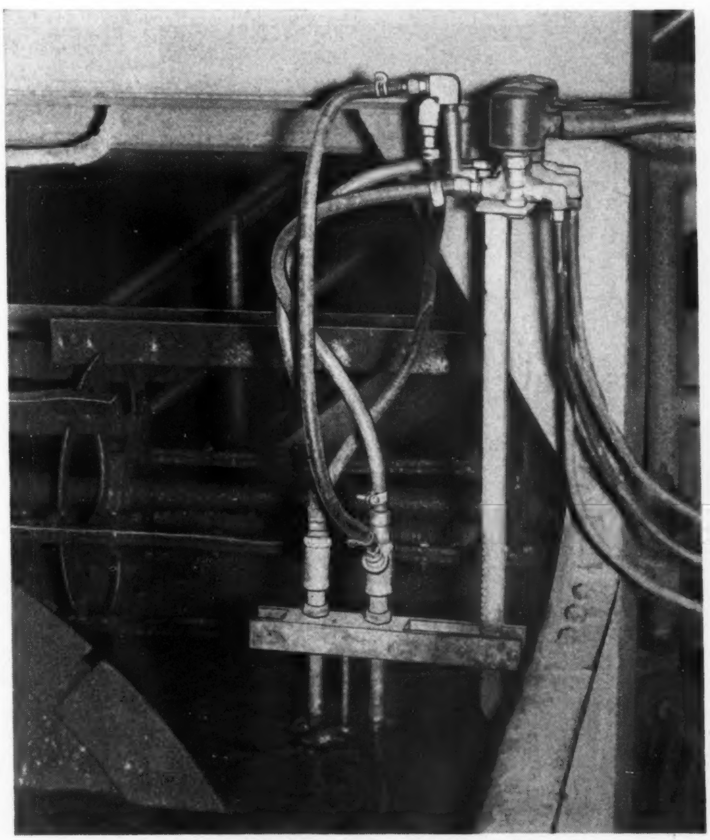
Under mill conditions the early type mechanical recorders were not stable and gave considerable trouble. However, the war-developed electronic strip-chart recorder proved an extremely rugged, yet precise, instrument. After installing the instruments considerable difficulty was experienced in making the apparatus function properly. Where radical changes in ore are made the pH electrodes are bound to foul. The construction of the assemblies were such that it was difficult to clean them. So the electrode assemblies were rebuilt so that they could be cleaned quickly. The factory now produces the type of electrode assembly eventually developed.

After numerous difficulties with the various junction boxes, which must be kept dry, a specially designed junction box was constructed and since then no difficulty due to moisture has been had. When it is considered that the current being measured is in the order of about one millionth of one billionth of an ampere, a leak of a few electrons per second becomes important. Yet it is accomplished for months on end and a hose may be turned on any part of the apparatus, excepting the amplifiers and recorder, without in any way effecting its operation.

For most part, the apparatus now requires only routine maintenance that takes but a few minutes per day. The maintenance program must be rigidly adhered to, however, if good results are to be obtained.

Experience taught that mill operators required a long education program on the use of pH. Because of the numerous reagents and conditions which affect pH there is a tendency on the part of practical mill men to consider it an unimportant parameter. However, there are advantages in the use of multiple pH recording on a single strip chart. Six electrodes, placed along the lead, zinc, and iron circuits, provide detailed data on circuit conditions.

Ore changes, even from a single mine, cause different degrees of oxidation. These changes affect the pH and when the pH record is compared



Adjustable bubble tube assembly in classifier

with the soluble salt analyses some definite ideas on the best method of treatment in the plant can be obtained. The changes in ore are usually caught immediately and not sometime later after the analyses are all in.

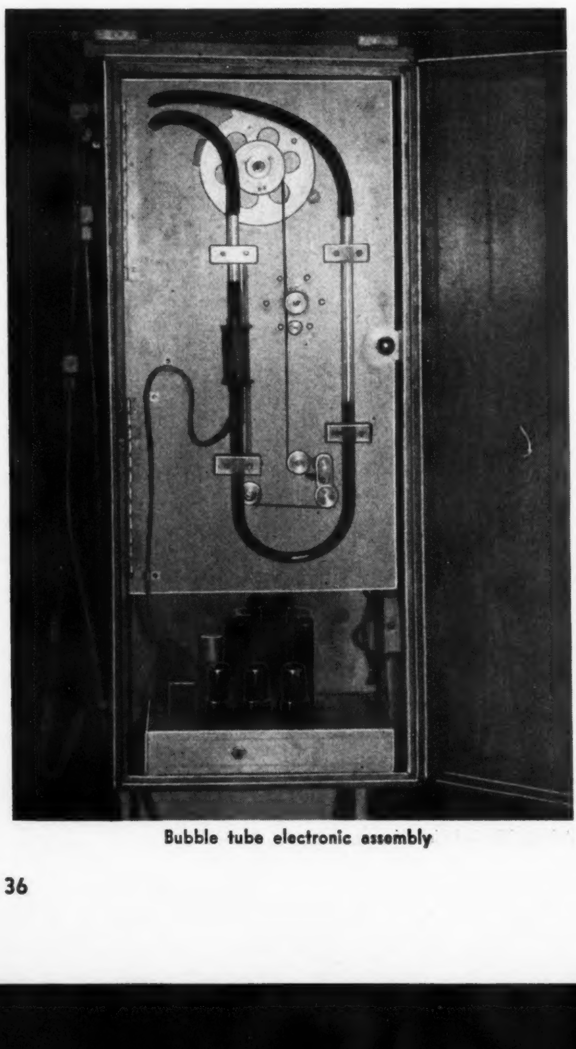
Man has multiplied his productive ability many times by applying mechanical power to perform useful work. The automatic control of milling equipment and measurement of its performance is a forward stride that extends still further man's mastery. Here a practical researcher describes several effective devices that serve to increase the efficiency of milling operations.

Mill Record Advantages

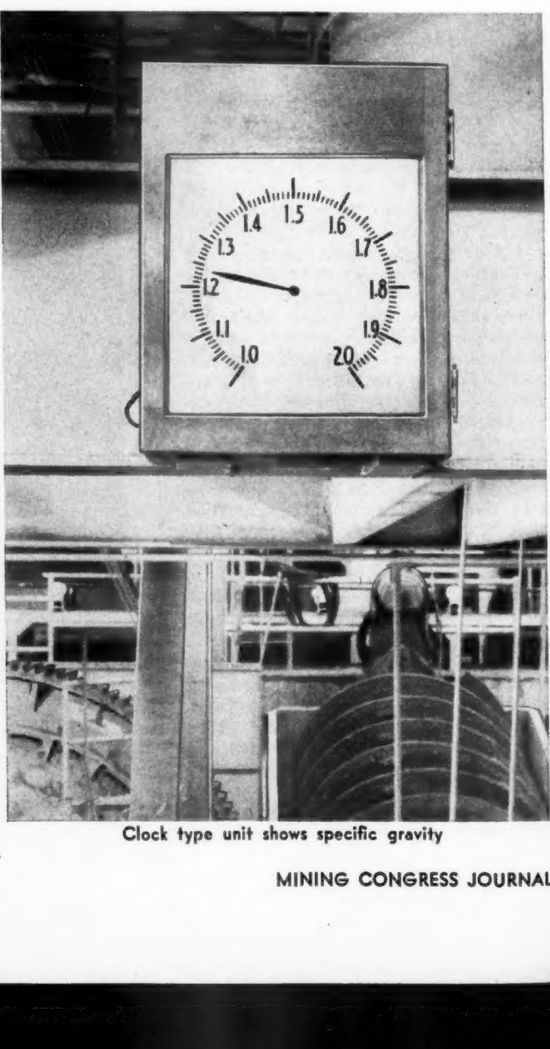
There are many values of pH at which, for example, a zinc circuit may be operated, but for the optimum quantity of reagents there is a most desirable pH. Once the mill crew has found the optimum of xanthates, frothers, etc., to use, then the pH is an important governing factor. In general it is different for each ore and may even depend on the grind.

A distinct advantage accrues to management from pH recording. The mill crews are often amazed at what the general manager can tell them about the mill operation almost hour by hour from the pH record and the analyses. One particular incident is brought to mind. Shortly after installation of a pH recorder at one plant the general manager spent considerable time explaining to the mill crew how the instrument would be helpful. On graveyard shift that night the lime feeder was left off for about four hours. Metallurgical results were poor, of course. The crew was caught red handed with no chance for an alibi. In the opinion of that crew it was not only a useful instrument but a "stool pigeon" as well.

It is unfortunate that most good practical mill men are not well versed in chemistry and physics. Often they find it easier to attack rather than to understand an analytical approach to their work. Through the use of measurements they have been able to get a much broader grasp of the physics of the flotation process. A particular case is worth presenting. The mill crew was having difficulty with the zinc cleaner circuit. They kept increasing the lime additions to the cleaner cells and after a period of time the pH at the head of the rougher circuit began to increase. They decreased the lime at the head end of the rougher circuit, yet the condition became progressively worse. Finally they removed the excessive lime from the cleaner circuit and after a lapse of time the pH at the head of rougher circuit dropped but the pH in the cleaner circuit became high again. The crew was unable to understand what had happened until the record was taken together with the reagent record and carefully explained. The excessive lime on the cleaner circuit had caused a large circulating load to build up in the cleaner cells which eventually found its way back to the head of the rougher circuit in increasing amounts, due to feedback. An oscillation in the process was set up which eventually found its way back to the cleaner circuit again. Not only did they create a bad situation but when they attempted to correct it, the effect of the oscillation they had started was to make the condition repeat itself.



Bubble tube electronic assembly



Clock type unit shows specific gravity

Continuous specific gravity record aids mill shift operation

These practical mill men now have an understanding of transient phenomena that they could never have obtained otherwise.

In addition to the benefits gained by the practical millmen, the technical staff has found the pH records most helpful in their work. They have a much better understanding of not only the process but have found the records useful in guiding future design. The effect of large capacity lags and transportation lags are clearly shown from the records and these conditions are being corrected through the use of fewer surge tanks. The effects of feedback are more clearly understood and an optimum operating point can be reached. The effect of reagent pyramiding is clearly shown from the pH records and is more easily controlled.

There are so many phases of flotation in which pH takes a part that no attempt has been made to control the pH automatically. However, one mill superintendent maintains that automatic control exists because it has been so helpful in aiding the crew to operate without his having to be on the mill floor 24 hours per day.

Improved Density Measurement

For a long time a search was for a suitable pulp density meter but each one offered on the market had defects. Unless an instrument was accurate and reliable over long periods of time it was best not to install it. There is nothing which will upset a program of this sort more than to have the mill crew lose faith in the instruments.

Most pulp density measuring devices operate by measuring the back pressure of a pair of differential bubble tubes. The instrument that does the actual differential measuring is usually some form of spring or beam balance. The differential pressure device receives its power to operate pilot control apparatus or a pen from the differential pressure itself. As a result, large differentials must be used on the bubble tubes. Large differentials are not useful in a classifier since the bubble tubes reach too deeply into the pool and do not reflect the overflow density. Of course, a sample of the overflow can be conducted through a chamber and the overflow specific gravity measured using a large bubble tube differential. Such contrivances are usually troublesome for various reasons.

To measure the pulp density in the classifier pool itself a unit was designed using a 3-in. differential on the bubble tubes. That meant measuring a minimum differential pressure of the order of magnitude of 0.015-in. of water or about 5/1000 psi. This was not a job for any mechanical balance that could be installed in a milling plant.

As a result an electronic manometer or differential pressure device was developed that is capable of measuring differential pressures in the neighborhood of 1/1000 in. of water, if so desired, and yet has substantial power output for the operation of a pen or control apparatus. As now employed a change in differential pressure of 1/1000 of an in. or ½ in. will cause a reversible motor to operate a balance means with a torque output of about 300 oz-in. There is no reason why this torque output could not be increased to several hundred lb-ft if such was desirable. The instrument in no way affects the sensitivity of the manometer.

This instrument, as employed directly, measures the height of a fluid manometer and not a voltage or other related factor. It is not affected by line voltage variations. It is a direct approach to the measurement of specific gravity. The instrument is extremely rugged. At the Pioche plant it is mounted on a column about 5 ft from a ball mill. Vibration does not impair the accuracy or reliability of operation.

With such a small bubble tube differential, turbulence in the classifier was somewhat troublesome at first, but a special bubble tube was devised that is not affected by turbulence. Some operators have attempted to install shields around the bubble tubes in the classifier to avoid the difficulties due to turbulence. This is not a desirable practice because shields disturb natural hindered settling in the classifier. This results in an inaccurate picture of the specific gravity.

In most applications where bubble tubes are used there is considerable difficulty due to sanding and clogging of the bubble tube orifices. This has been eliminated through an electronically controlled arrangement for periodically flushing out the bubble tubes from the *inside* with high pressure water, without in any way affecting the accuracy of the meter or injuring it. The instrument is readily adaptable to multiple recording from a single manometer. At Pioche the specific gravity is measured in three places in the plant automatically using a single electronic manometer.

Multiple Controls Effective

There is now in operation at the Bauer plant, a density meter which measures the pulp density in six places in the circuit. The results are recorded by an electronic strip chart recorder of standard manufacture. Results are on the same type of chart as is used for pH. Much useful information from the two records is being gained. The accuracy of measurement with this instrument is plus or minus 1/100 units of specific gravity and this accuracy can be maintained over long periods of time. This apparatus has been operated for as long as 13 weeks without recalibration being necessary. A retractable bubble tube assembly is used which can be readily raised out of the pool for inspection.

Another feature of this instrument is that, if so desired, it may be calibrated empirically. The air supply to the bubble tubes can be varied in a way to make the instrument read the specific gravity of the classifier overflow, as determined by an expert with a specific gravity bottle and balance. This practice is desirable as crews need not be educated to a new gravity scale. It also makes calibration a simple operation.

In the development of this instrument it will be noted that electronics was employed liberally. There has never been any control device yet devised by man that surpasses the electron tube for versatility. The absence of moving parts, the extreme sensitivity and stability of electronic circuits, the large power handling capabilities, and the reliability of tubes makes electronics desirable under the rugged conditions that prevail in ore concentrating plants. A properly designed and constructed electronic device will require less maintenance than its counterpart in a mechanical device.

So far the density meter has not

(*Continued on page* 96)

SYSTEM...

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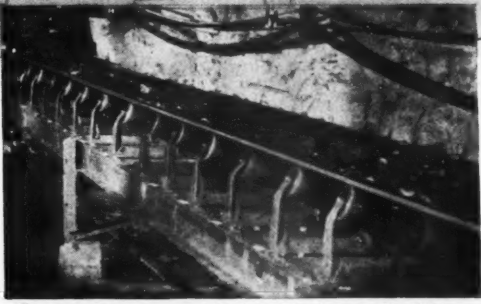

2. UP IT RIDES . . . on U. S. Rubber's amazing Ustex-Nylon Belt. Ustex for strength, Nylon for flexibility.

3. TOP OF THE SLOPE, 643 feet higher than the beginning. Coal has traveled 2600 feet on 15° incline, now transfers to ¼-mile overland belt also made by U. S. Rubber.

4. HERE IT IS at the end of the 3900 foot short-cut that saves 6000 feet of travel.

When you have a materials handling problem—underground, slope, or surface, call in a U. S. Rubber engineer. Write Mechanical Goods Division, United States Rubber Company, Rockefeller Center, New York 20, New York.

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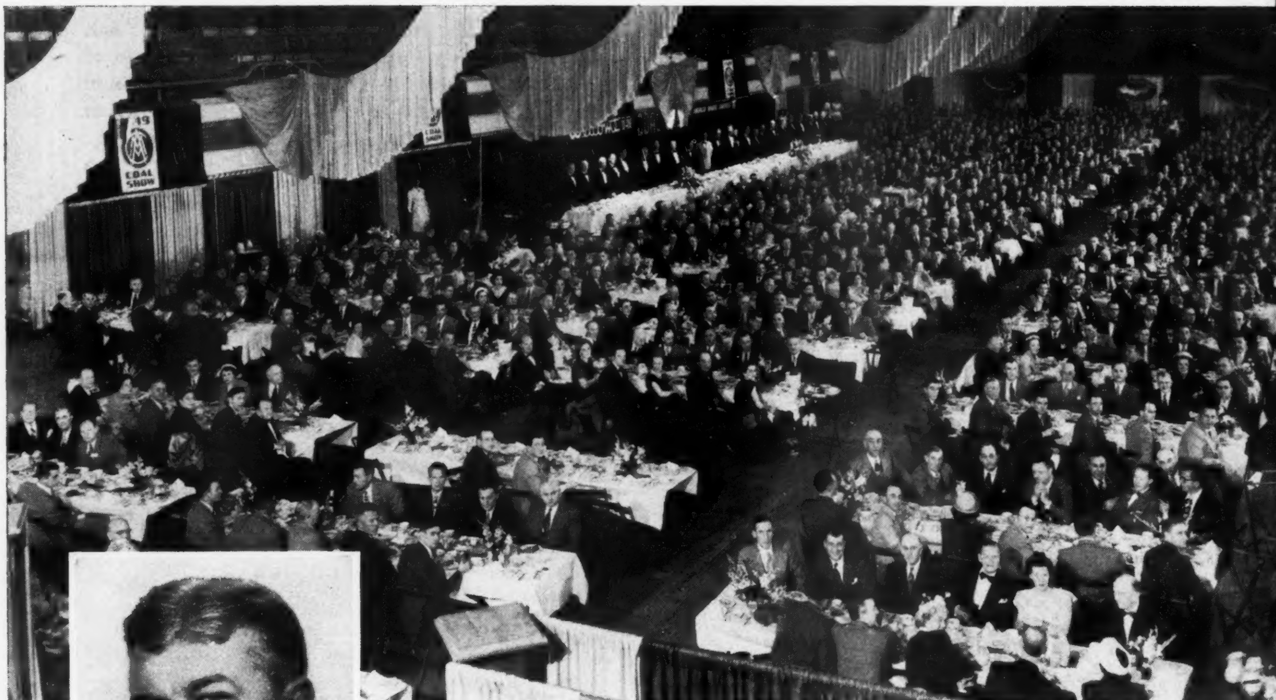
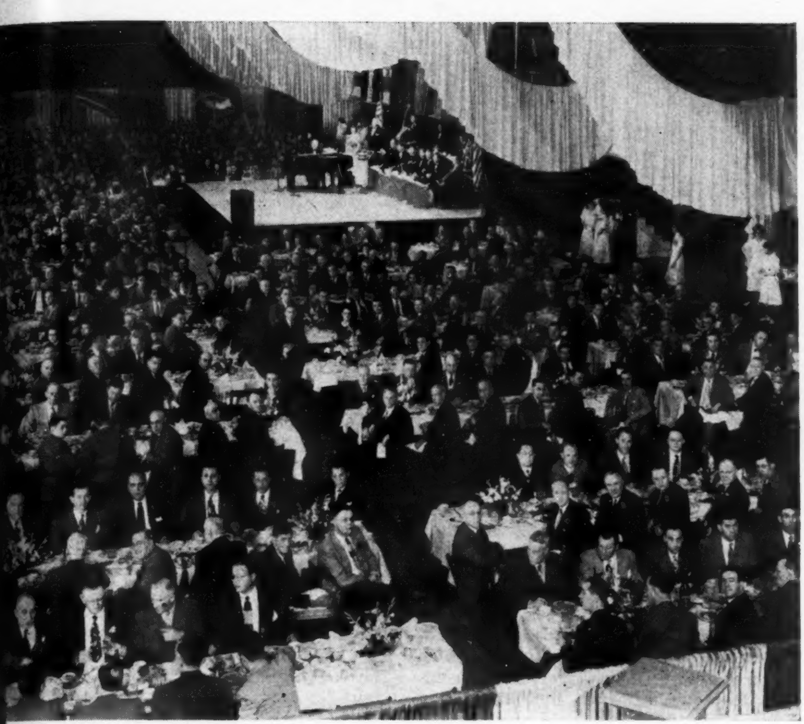


A huge gathering enjoyed the

1949 Coal Show

L. Ebersole Gaines
The New River Co.
National Chairman

People came from every state and from abroad to hear Convention speakers



...evening of the Annual Banquet

...Sets New Records

THE FOUR DAYS of the 1949 Coal Show, held in Cleveland's Public Auditorium May 9-12, marked the great postwar progress of the coal mining industry towards more complete mechanical mining. The resilience of the coal industry, freed from war-time controls, and functioning as one of the prime exponents of free enterprise, was apparent. In less than four years after the cessation of hostilities, amazing advances have been made by manufacturers and operators in their joint objective. Their achievement in supplying the Nation's need for quality coal with greater safety and with the increased efficiency made possible by the accelerated pace of mechanical mining was the dominating note of this outstanding Coal Show.

Attendance Reaches New High

In this great drive for modernization of mining techniques and equipment, the attendance record signifies that the coal mining industry and mining manufacturers are maintaining their policy of enthusiastic cooperation. Final registration figures showed a total attendance of 13,744 persons. Of this number 5959 were operators. These included coal mining men from every producing area in

As they entered, visitors saw this view of one of the five main Exposition halls

the United States and coal industry representatives from ten foreign countries. Also present were a substantial number of men from iron ore, salt, gypsum, potash, copper, lead-zinc, limestone, and other mines, although more than 95 percent of the attendance was from the coal industry.

Exhibitors representatives totaled 5214. These included not only sales and technical representatives but also large numbers of production men from exhibitors' plants—who visited the Show to get a broader understanding of the coal mining industry and to derive new inspiration as to the importance of their work. Representatives of other manufacturers and distributors, including many manufacturers interested in applying equipment on display to their own operations, added up to 1865. The ladies attending numbered 634.

A comparison with the previous record-breaking Coal Show in 1947 shows that attendance was up 51 percent; the number of exhibitors was up 21 percent and the actual exhibit space occupied was 43 percent greater.

This year a streamlined method of registration was inaugurated whereby coal mining men and representatives of manufacturers could register in advance with the Washington office of the American Mining Congress. More than 7000 persons availed themselves of this opportunity and received their Coal Show "credentials" well in advance of Convention week.

Advance registrants received hand-lettered identification cards which were drawn in characters approximately one-half inch high for ready identification. The new system did away with the usual delays incurred in registering at the Auditorium and even those who did not have their "credentials" were registered in a remarkably short time.

Cleveland hotels were filled to capacity and all available accommodations, including a considerable number of rooms in private homes, were needed to house the throng of Coal Show visitors.

Committee Work Well Done

The Program Committee, the several committees on arrangements, and the Manufacturers Division, which sponsored the comprehensive exhibits, played a major part in assuring the success of the Convention and Exposition.

Headed by L. Ebersole Gaines, president, New River Co., and National Chairman of the Program Committee, a large number of operators and manufacturers worked together to plan the excellent series of papers on the economic and operating problems of the coal mining industry.

High commendation is due the Manufacturers Division, headed by Chairman J. H. Fulford, Jeffrey Manufacturing Co. They sponsored the Exposition which presented the most complete display of modern mining machinery, equipment, and supplies that had ever been gathered together under one roof for examination by members of the coal mining industry.

Under the chairmanship of J. W. Woomer, the Floor Committee deserves credit for helping the chairmen in directing the sessions, keeping the time schedule, and assisting, where necessary, in promoting discussion. The Welcoming Committee under the chairmanship of Ralph N. Hanes,

Upper Lakeside Hall displayed equipment ranging fro

United States Rubber Co. earned high praise for its fine performance in making convention-goers feel at home as they entered the broad doors of the Cleveland Public Auditorium.

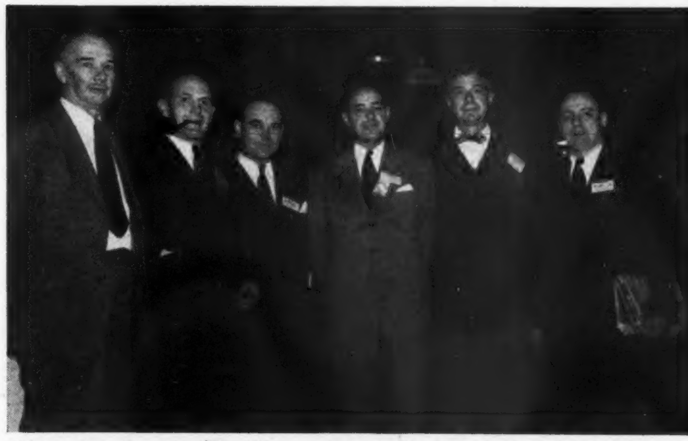
The Coal Division, led by Chairman S. M. Cassidy, Consolidation Coal Co. (Ky.), gave the fullest cooperation in providing both technical help and advisory assistance in the preparation of the program and in the selection of the subjects that were presented. Nearly 200 coal operators and manufacturers of the Coal Division carry on the year-round activities which form a foundation for the annual meetings that bring the industry the thoughts of foremost leaders.

Ralph Hanes
Chairman
Welcoming Committee

Technical Sessions Open

On Monday afternoon, May 9, following a half day set aside entirely for inspection of exhibits, the Convention was formally opened by Julian D. Conover, Secretary, American Mining Congress. Following brief remarks, he presented L. Ebersole Gaines, Program Committee Chairman, who expressed appreciation to his committee members, and complimented exhibitors on the unusually comprehensive displays. He paid special tribute to the speakers on the program for their fine contributions and welcomed Convention visitors.

A. R. Matthews, president, Clinchfield Coal Corp. was then presented as Chairman of the Trackless Mining Session. Methods of belt-conveyor loading, tractors, and trailers for supply haulage, and a symposium on continuous mining marked the absorbing group of technical papers.



Prior to formal opening, Exposition was inspected by G. B. Southward, J. D. Conover, W. A. Wirene, J. H. Fulford, L. Ebersole Gaines, and J. T. Ryan, Jr.

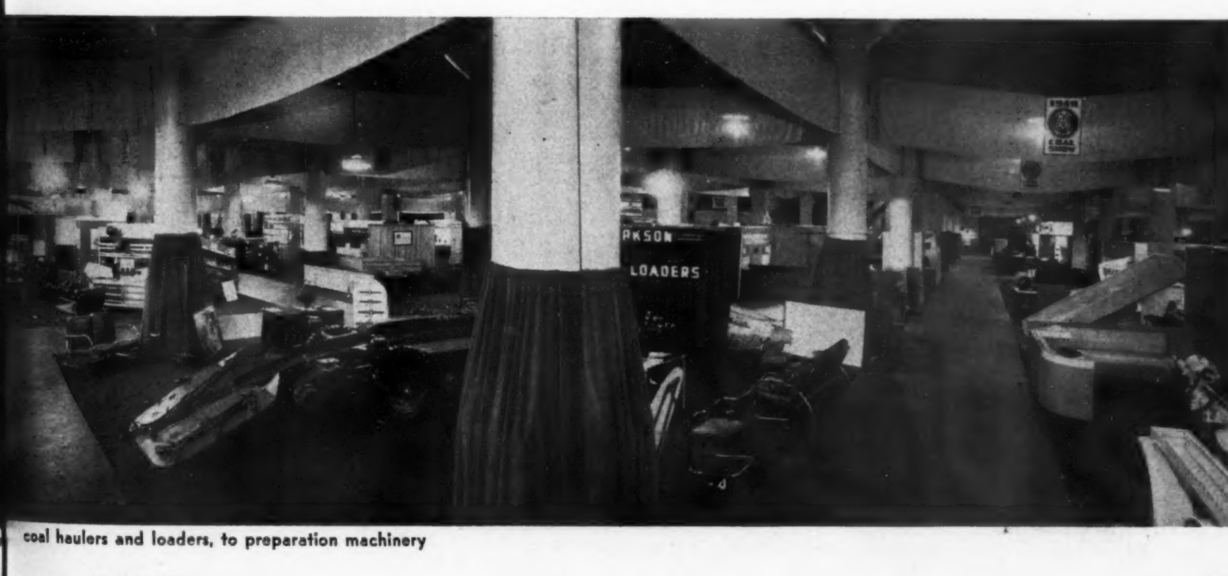
The Sessions—A Strong Attraction

Pre-session motion pictures, selected for their wide general interest, proved to be real drawing cards. All sessions were well attended, attesting to the Program Committee's choice of topics of the highest interest to the coal mining industry.

Running concurrently with the session on Trackless Mining on Monday afternoon was a session on Maintenance and Ventilation. Glenn B. Southward, Mechanization Engineer, American Mining Congress, opened this session and after presenting S. M. Cassidy, Chairman of the Coal Division, he introduced the session chairman, David Ingle, Jr., president, Ingle Coal Co. In addition to the wide interest in the papers on the maintenance of underground equipment and preparation plant equipment, the group of presentations pertaining to auxiliary ventilation drew wide discussion from the floor.

A series of papers on utilization and marketing on Tuesday morning attracted a large group to hear the opinions of experts on this critical topic. The industry was assured of the long-term demand for coal as the nation's basic fuel.

Papers on face operations held the attention of coal mine operators on Tuesday afternoon. The application of tungsten-carbide bits, methods of breaking down coal, and the use and care of trailing cables were ably handled by experts in their field. At the same time the strip mining ses-



nging fro coal haulers and loaders, to preparation machinery

Operating machinery drew interested groups


Coal operators pressed exhibitors' representatives for information

New mining machines attracted mining men interested in boosting efficiency

sion, where recent developments in overburden drilling, blasting in open-pit mining and deep stripping methods were discussed, held the interest of operators desirous of improving methods and practices in this important branch of the industry.

Surface preparation topics were treated on Wednesday morning, with interest centering on methods of dewatering and drying coal and dense-media separation processes.

On Wednesday afternoon concurrent sessions were held on underground haulage and strip mining. Papers were presented on locomotive trip dispatching by telephone and radio, the latest developments in belt haulage, and shafts vs. slopes for hoisting. The strip mining session discussed anthracite practices, mapping by aerial photography, power distribution, and land regeneration. At the same time a round-table discussion was held on steep-pitch mining which brought into focus the various methods used.

The management session, held on Thursday morning, included presentations on management-employe responsibility for mine safety, attracting young men to the coal industry, and management-employe relations. These papers, by men of long experience, and especially the panel discussion by industry leaders on management-employe relations, were of deep importance to the entire industry, as shown by the fine attendance. Thursday afternoon was left open for study of the diversified exhibits.

Abstracts of convention papers appear in this issue, beginning on page 50.

Manufacturers Divison Meets

The Manufacturers Division of the American Mining Congress met on May 10 with J. H. Fulford presiding. Secretary Conover reviewed the activities of the Division for the past year, including the work in connection with steel allocations, as well as the results of the Metal Mining Exposition in San Francisco and the problems dealt with in planning for the Coal Show.

New members elected to the 21-man Board of Governors were Charles L. Bowman, president, Bowdil Co.; John F. Graham, general manager of sales, American Steel & Wire Co.; H. N. How, president, Western Machinery Co.; William A. Wirene, manager, materials industries division, General Electric Co.; and Guy V. Woody, manager, basic industries department, Allis-Chalmers Manufacturing Co. Members reelected to the Board were John P. Courtright, A. S. Knoizen, H. H. Pancake, and C. B. Stainback. Chairman Fulford commended retiring members P. F. Bauer, J. J. Huether, Thomas McNally, and A. E. Pickard for their splendid service to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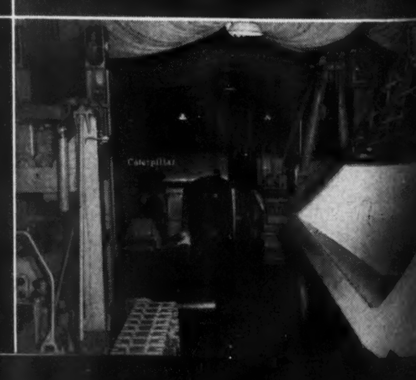
BATTERY POWER
GOULD

Caterpillar


IRWIN



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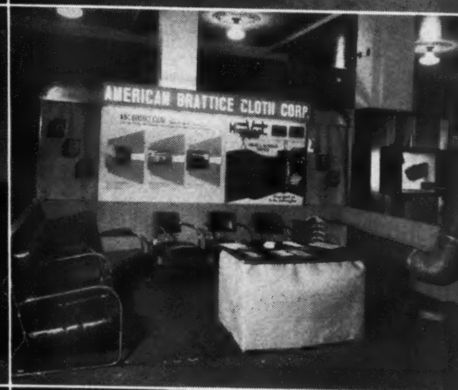
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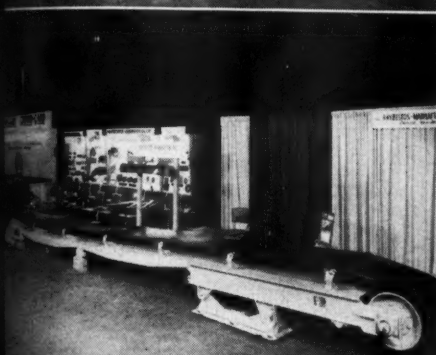

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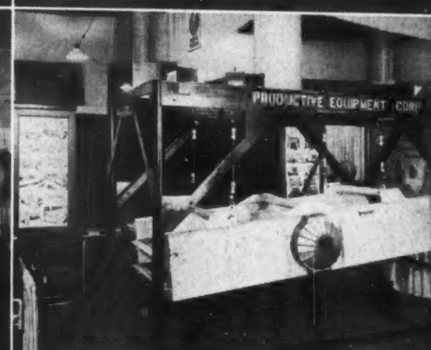

PRODUCTIVE EQUIPMENT CORP

C&O CHOOSES COAL
COAL
CHESAPEAKE AND OHIO RAILWAY
C&O CHOOSES COAL
PROGRESS


HARNISCHFEGER
P&H


GOODMAN



KENNAMETAL


MINE SAFETY


MARION
POWER SHOVEL COMPANY


ALLIS-CHALMERS
Car Shaker
COAL CAR SHAKER


MACWHYTE


DEISTER CONCENTRATOR COMPANY


VICTAULIC PIONEER AND WORLD LEADER
FLEXIBLE PIPE COUPLINGS AND FULL-FLOW FITTING
IMMEDIATE DELIVERY FROM STOCK


NATIONAL MINE SERVICE COMPANY


SKF
SKF

the Manufacturers Division and the coal mining industry.

At the meeting of the Board of Governors of the Manufacturers Division officers for 1950 were elected as follows: M. L. McCormack, manager, Rock Drill Department, Ingersoll-Rand Co., Chairman; John T. Ryan, Jr., executive vice-president, Mine Safety Appliances Co., first vice-chairman; C. B. Stainback, manager, industrial sales department, Westinghouse Electric Corp., second vice-chairman; and John P. Courtright, vice-president, Marion Power Shovel Co., third vice-chairman.

Exceptional Exposition

Occupying 94,000 sq ft of floor space in the huge Cleveland Public Auditorium with displays of all types of mining machinery, equipment, and supplies, the 228 exhibitors deserve the highest praise for the completeness, attractiveness, and interest that was built into their exhibits. Heavy machinery, such as cutters, continuous mining machines, loaders, conveyors, locomotives, fans, shuttle cars, mine cars, cleaning and preparation equipment, along with all other types of equipment and materials used in modern coal mining, attracted the attention of large groups of people. Much of the equipment was operating so that the machinery could be inspected for its operating characteristics.

Throngs of people were constantly in motion, up and down the aisles of the four levels of the Auditorium, as they made their way to booths of specific interest to them. An estimated two hours was required merely to walk by all of the exhibit booths.

All types of supplies and accessories used in and around mines were available for study. Manufacturers' representatives had a strenuous week in answering the many questions put by the thousands of operators eager to derive the maximum benefit from the extensive arrays of exhibits.

Tops in Entertainment

The traditional Coal Miners Party was held Tuesday night in the Arena of the Public Auditorium, which had ample space to accommodate the 1400 people who attended. A buffet dinner was enjoyed by all and a floor show of unusual brilliance kept all eyes focused on the stage. Dancing followed the fine performance, which included a spectacular act on the trampolin, expert tap dancers, and the familiar barber shop quartet. A simulated overimbiber (not a coal miner), who attempted to climb a lamp post to light a cigarette, delighted the audience.

Peak social event of the week was the Annual Banquet which also took place in the Arena of the Public Auditorium on Thursday evening. With 1500 people in attendance this huge hall presented a gala appearance.

At this climaxing occasion of Coal Week, L. Ebersole Gaines, presiding as toastmaster, hewed to the line in adherence to the promise of a "speechless banquet." In a brief comment he stated "We are bringing to a close the largest and finest Convention and Exposition that the coal mining industry has ever held. . . . The representation here is a great example of the power, the might, and the dignity of an industry which for 75 years has contributed the fuel supply that made possible the greatest industrial development the world has ever known.

"It is the fuel industry and its industrial development which have enabled this country to fight, in 25 years, two great wars whereby it can maintain the standards of freedom on which this country is based.

"This Coal Convention and Exposition, an example of the collective confidence of operators and manufacturers, is the successful outcome of individual initiative and of the American free enterprise system."

appreciation for the outstanding results of the efforts of the exhibitors who put on the great exposition. Mr. Gaines then introduced other head table guests who acknowledged their introduction by rising. Following this short ceremony the attention of the banqueteers was turned towards the stage and the able performers who entertained the gathering. Guest artist of the evening was Frances Langford, screen and radio star.

Ladies Have Fun

A special program was designed to entertain the ladies. Monday afternoon, they held a "get together" tea and on Tuesday they enjoyed a sightseeing tour to points of interest.

Following Wednesday's luncheon, a fashion show was held at one of Cleveland's outstanding department stores where the visitors from the coal areas saw the latest fashions designed to enhance their personal appearance and detract from the appearance of their husband's purse.

Greeting old friends and making new ones at the Coal Miners Party

Mr. Gaines introduced Howard I. Young, President of the American Mining Congress, who recalled past Coal Conventions in commenting upon the great progress shown by the 1949 Coal Show. He expressed great optimism and stated "With the mechanization, the beneficiation, and the conversion of coal into oil and gasoline, the coal industry today faces a brighter future than it has at any time in the history of the industry." In his remarks he thanked coal operators and manufacturers for the excellent cooperation they have always given to the American Mining Congress.

S. M. Cassidy, Chairman of the Coal Division spoke briefly on the fine industry-wide joint endeavor that went on behind the scenes in preparation for the 1949 Coal Show.

J. H. Fulford, Chairman of the Manufacturers Division, expressed his

Future Convention Plans

Negotiations are under way for returning to Cleveland for the 1951 Coal Show. It was announced that the three-day 1950 Convention (without an exposition) will take place in Cincinnati, April 24-26.

Only Hollywood-type adjectives can adequately describe the 1949 Coal Show. Even then, "supercolossal" would undershoot the mark in effectively telling the story of an Exposition and Convention which will go on record as having surpassed anything that has gone before. The 1949 Coal Show demonstrated the exceptional effort and ability of the coal mining industry to cooperate in solving the problems of better means of production, to provide the American people with a steady flow of quality coal in the competitive era that lies ahead.

Abstracts of

CONVENTION PAPERS

PAPERS delivered at the convention sessions are presented here in condensed form. They will be published in full, together with discussions and illustrations, in the 1949 Coal Mine Modernization Year Book.

Face Operations

High Speed Cutting and Drilling with Tungsten Carbide Bits

By **Carl A. Burgener,** Division Engineer
Peabody Coal Co.

OUR experience has been with small mines in the Southern Illinois coal fields, and from this vantage point, we have seen few, if any aids afforded industry that are more dramatic, more sensational and more revolutionary than cutting and drilling with tungsten carbide tipped bits. Their use was adopted in the United States about 1944 and gradually grew in volume. When we remember that some sets of bits cut nearly 400 places with one grinding, we begin to realize just what a carbide tip can do—approximately 150 miles of cutting from one grind in some conditions. Its superiority to the steel bit is roughly 100 to 1 for wear.

Examination of several samples of coal from Southern Illinois proves that, of the impurities present, iron sulphides are hardest. Since iron sulphides are distributed throughout the coal seam, the cutting bit must resist their abrading action, and remain sharp enough to cut coal with a considerable amount of sulphides present. There is not enough difference in scratch hardness of hardened steel and the sulphides to provide a bit material of a satisfactory cutting life. Tungsten carbide has a scratch hardness of 12, in comparison with a hardness of 7 to 7½ for sulphides; for this reason, several methods of improving bits by use of tungsten carbide have been devised.

The only good way to arrive at a worthwhile conclusion as to the value of these types of bits is to study their operating characteristics, useful life, and costs in comparison to these same criteria for plain steel bits. Time studies at our Mine No. 43 over a representative number of shifts furnishes considerable information on which to base these conclusions.

The first type considered is the common steel bit. A summary of the results shows that the average cutting time for each of the 12 rooms during an average shift was 15 minutes; the average bit changing time was 13 minutes, and a total of 80 bits were used. Since approximately 37 tons of coal were taken from each cut, the 12 places would yield approximately 444 tons. Each of the 80 bits used would then represent approximately 5½ tons of coal mined, at a cost of $0.005 per ton.

The majority of our time study data covers the use of the cemented carbide-tipped bit, with a Goodman shortwall, equipped with a mechanical bugduster. These studies were made in the same sections of the mine as were the studies of the plain steel bit. The average cutting time was 13 minutes in contrast to 15 minutes with the plain steel bits. Eighteen places were cut instead of 12 with the plain steel; these 18 places produced approximately 666 tons of coal, or an increase of 50 percent over the 444 tons produced by the plain bit. The first set of the carbide-tipped bits cut 383 places, producing 11,962 tons of coal, at a bit cost of $0.0046 per ton, and cutting 239 tons per bit. Three of these bits had the tips broken off, and the balance of them were reground and put back into service. After going back into service, these same bits cut 207 places with a coal production of 5922 tons. This indicates that the cutting capacity is reduced to about half of the original capacity after the first sharpening. Our experience has shown that this capacity is cut in half again after the second sharpening. However, it must be realized that the bit cost is labor alone for the second and third usages. Taking into consideration the life of the bit, brings the above cost down to $0.0029 per ton.

After discussing experiences by other companies and in other fields, the paper continues:

Another important use for cemented carbide tips not mentioned heretofore is on drill bits. Approximately the same advantages of decreased drilling time, fewer bit changes, less bit sharpening, and hence increased production and lower costs, result from the use of this type bit in place of the conventional type bit. In a drilling test conducted in a Western Pennsylvania coal mine, cemented tungsten carbide tips drilled 2700 ft of coal and slate in the Pittsburgh seam before dulling the first time. One bit drilled 300 nine-ft holes as compared to 300 conventional type steel bits for the same amount of footage under the same conditions. Time tests taken in the same mine indicate that the cemented carbide tipped bits drill approximately 36 percent faster than steel bits. By taking advantage of the increased drilling speed, at least three or four more places can be drilled per shift. If these bits are properly taken care of, that is, ground when they are dull, one bit can continue to give good service for as long as 12 or more regrinds.

The chief problem in cutting is breaking tips. In the manufacture of the bits, the tungsten carbide must be secured to the shank by soldering. The silver solder is fairly satisfactory, and where carefully used, does a good job of holding the carbides in place. The carbides, although hard, are not particularly strong and must be well backed up by a shank of good steel at high hardness, as heavy, concentrated loads such as sulphur balls impose, could bring enough pressure on the tips to cause failure of the inserts by flowing the steel backing.

Another cause of the failure of the carbides would be snagging on shortwall machine underframes where chains are allowed to become too loose. The cut-through walls of shortwall underframes are a familiar sight in almost all coal mines, and it is not hard to visualize what a banging the carbide tipped bits take in bouncing off the steel wall and tilting shoe jacks when cutter chains are allowed to run badly out of adjustment. Dragging across floors, skids, jack pipes and rails, also takes a toll from the carbide bits that can be guarded against by using a little care.

Another prevalent method of inflicting sudden death on carbides is use of the chain to kick the end of the cutter bar either into or away from the rib—away from the rib being the worse of the two. Since cutter chains are assembled "laced" to a certain pattern and the individual units of the pattern repeat themselves according to the lace of the unit, it is desirable for smooth cutting to have all bits set to a uniform gauge, so that they will all cut the proper depth.

There are a number of factors entering into any consideration of the merits of carbide tips versus steel bits for cutting. The two most important and probably the two factors that will determine whether or not their use will be economical is cost per ton for bits and cost per ton for labor. If the labor cost is high because of time consumed in setting steel bits, and perhaps due to delays to crew personnel other than the cutting machine men, because of being out of coal, it might be practical to use carbide tipped bits instead of steel, even though the carbide cost several times as much per ton than the steel bits.

Methods of Breaking Down Coal at the Face

By **W. O. Smith**, General Superintendent W. G. Duncan Coal Co.

EARLY in 1938 the W. G. Duncan Coal Co. of Greenville, Ky., which had operated mines in Muhlenberg County for a number of years, decided to experiment with a different method of shooting coal in order to decrease the percentage of fines, increase safety and eliminate smoke. Approximately 3000 tons of coal were loaded per day on a double shift. This tonnage contained 54 percent 1¼-in. screenings and as the market was favorable for the sale of larger sizes, it was imperative that fines be reduced in quantity.

At the time the Western Kentucky No. 9 seam was being mined. This will average about 56 in. in height and is remarkable in its uniformity of thickness, and chemical analysis over a wide area. Cutting and shooting problems vary somewhat at different locations, but as compared with other seams are relatively uniform.

Near the bottom are numerous sulphur lenses which are difficult to cut, and, as they are lenses rather than bonds, they will vary in size and number. At the top there are other sulphur lenses which make shooting still more difficult. The reason for this is not clear but it is known from practice that when they are numerous, the coal will not break away easily; they also give most trouble when present in the rib and interfere with shearing at the rib from the shot.

Occasionally at the top there are about 2-4 in. of brashy or soft coal and sometimes, if a shot is placed too close to the roof, this material will shoot out. Furthermore, the roof immediately above the coal will sometimes be of draw slate from which the coal will separate readily or, on the other hand, it may be made up of numerous "horse backs" or "nigger heads" which form an irregular roof from which the coal separates with considerably more difficulty. The shots must be raised or lowered according to the variations in top coal and roof conditions.

About 25 percent of the coal is left in pillars to support the roof load as it is not the custom in this field to draw pillars because of cost. To get maximum extraction and continue to support the overburden, the rooms must be kept straight, the rib lines regular and the pillars must not be unduly shattered. Little if any attention is paid to cleavage planes in determining direction of entries or rooms and they have not been considered from the standpoint of drainage, haulage, and, as much of the coal is under shallow cover, from the topography. Many of these conditions might tend to increase the quantity of fines formed during mining in the cutting and shooting processes.

The paper then tells how experiments started in 1938 were continued with types of permissible explosive and with Cardox, until interrupted by World War II.

By 1942 the demand for coal was increasing. Size was not as important as production. The haulage system had changed and it was more difficult to handle supplies. The stock of shells had decreased due to loss in the mines and deterioration. Heaters were hard to secure. Because of these factors, a system of shooting was adopted using only two Cardox shells in the entries and two in the rooms, supplemented by shooting additional breaker holes with powder. This arrangement was continued until 1948, the intervening years being marked by the struggle on one hand of obtaining production and on the other hand of obtaining supplies. Little attention was paid to obtaining the utmost efficiency so long as production could be maintained.

After the end of the war, a return was made to a method of cutting, drilling, shooting, and loading which would give the greatest production of the larger sizes of coal at a minimum cost. Six 10 RU universal cutting machines were bought at this time to reduce the cutting cost for the six loading units then in use. An expenditure of about $10,000 would have been required to repair the charging equipment and to buy enough shells to shoot Cardox entirely, so it was then decided to experiment with Airdox instead of making this expenditure. It was thought that this method would be cheaper in first cost and operating cost and that it would also decrease the amount of screenings.

The use of Airdox is still in the experimental stage. It is difficult to compare the screenings now produced with former results because a washing plant has been added to the tipple but there is a marked increase in the larger sizes, particularly in the 7-in. lump. After another year of trial, more complete information will be available, but enough is already known to prove that Airdox has the following advantages:

The roof is not disturbed to the extent it was before so that less secondary timbering is required.

Working places are at all times free from smoke and fumes. The face cycle is not delayed by waiting on smoke to clear away from the face.

The cost of tamping materials is eliminated as well as the danger and cost of storing, transportation and handling explosives.

The time required to break a face is no greater than that required to load, tamp, and shoot the same face with explosives.

The coal produced is firmer.

The ribs and face are not as shattered so that accidents from falling coal are reduced.

The increase in the proportion of lump and egg sizes has resulted in an increased realization.

No accurate comparison of shooting costs can yet be made, but Airdox appears to be cheaper than Cardox or powder.

Several precautions are necessary. Care must be used in rolling and unrolling the coils of copper tubing so that it is not fatigued to the point of failure. A break of the tubing under pressure can cause a dangerous cloud of dust unless the place is properly rock dusted. Feeder lines should be kept out of haulage entries. Feeder lines should be carefully protected from possible contact with live wires. (See U. S. Bureau of Mines safety bulletins for others.)

The experiments with Airdox will be continued, but it already seems certain that it is the best method of shooting this mine.

Continuous Mining

Early Progress and Present Developments

By **Gerald von Stroh**, Director of Development Committee Bituminous Coal Research

CONTINUOUS mining is a complex system, not a machine. As Americans, we are probably the greatest mis-users of language in the world; although this makes our conversation colorful and interesting, it also, at least from an engineering point of view, creates confusion. The problem of definition is not trivial and has contributed to the retardation of industry.

What, then, is continuous mining?

Reduced to its simplest terms, in our opinion, its definition is "to approach a solid encompassed on five sides, reduce a portion of the solid into separate pieces or a different form, and transport the product of reduction to the surface without interruption." You will note that our definition stated: reducing the solid to separate pieces or changing its form. By the latter, we of course are referring to underground gasification or dissolving the coal through some solvent, in a manner such as water is used to dissolve salt, which is then pumped to the surface.

However, considering the present status of evolution in this country, the problem of paramount immediate importance is to design a continuous mining system which will provide the same product as now being used. So on the basis of reducing the solid to separate pieces and transporting the pieces to the surface or preparation plant, we find the two following elements are essential:

(a) A machine or device to reduce the solid to separate pieces without interruption

(b) A transportation system or device that will take the separate pieces and transport them to a commercial transportation system or preparation plant

For these two elements to operate without interruption, service functions must be improved accordingly. For example:

(1) A roof control system must be devised that will permit holding the overlying strata together; with a coal mining rate of 2-4 lineal ft of advance per minute. From the point of view of supply only, this would seem to preclude the use of conventional roof timbering methods in most mines.

(2) Rock dust must be applied at this same rate of 2-4 fpm.

(3) Ventilation must be considered as a factor and will probably need to be better than at present. It is possible that the high rate of reduction will increase the cubic feet of gas per minute that the ventilation system must handle.

(4) Dust control may become a greater problem. Even if the amount of dust per ton is reduced the tons handled per shift, per place, will be considerably increased.

(5) Illumination will need considerable improvement with the increased rate of production, similar to the need for better lights on an automobile at 60 mph than at 20 mph.

(6) Supply handling will need to be accelerated and power facilities increased.

Practically all of the elemental and functional improvements will require new systems and equipment, and in some instances, several types of equipment may be needed to meet the requirements of a given function. To restate my opening premise, continuous mining is a complex system, not a machine.

Mr. von Stroh then gives a history of the developments of so-called continuous mining machines, starting with the English Channel machine operated in 1870, and continuing with descriptions of early types of coal entry drivers as developed in the 1920's. He then gives an outline of the procedure used by the mining development committee and concludes:

The B. C. R. Committee

In regard to the development of a continuous machine and our other work, we have frequently been asked—why should the committee be any more successful than were the mining machinery builders and individual operators in the past? There are several reasons for this.

First and foremost is that at no time in the experience of the industry has this degree of cooperative effort been achieved on practical mining problems. Available to the committee are the technical and operating staffs of the subscribers which, in effect, means the industry as a whole. Therefore, we can draw upon the broadest possible background of experience.

Secondly, nowhere among either the operating companies or machinery builders do we have a group of engineers, working on such a problem, who are isolated from the day-to-day emergencies of production. If the permanent staff of the committee is successful in meeting our requirements, it will not be because we are particularly intelligent; it will be because of the cooperation of both mine operators and machinery builders whose assistance has been requested. A further factor in our favor is that our permanent staff can consider the over-all problem on a long-range somewhat idealistic basis, uninfluenced by any secondary emergencies or considerations.

In summarizing this paper, we repeat that continuous mining is a complex system, and feel that the first and most important element to be developed is what is popularly termed a continuous mining machine. The committee has progressed to the point where a test unit of a basic design philosophy, which has been evolved out of the work of the committee to date, is being built and will be tried. This design philosophy is a considerably different approach from other efforts to date, in that it was evolved by an abstract study of the problem rather than by starting with an idea for a machine and building from that idea. In effect, we have tried to handle the problem like a quantitative equation, in which the unknowns are listed in their proper sequence and then one by one eliminated. At the present time, we believe that we have set up the equation and are in the process of eliminating the unknowns.

This is not a visionary program. Remember, it is guided by 11 practical experienced leaders of the coal industry. Each idea and principle must be checked and approved by a total of 23 men with hard, practical, day-to-day experience with the problems of coal mining.

The fact that the committee is continuing with the development of a continuous mining machine should not in any way detract from the achievements of the past, particularly from those announced in recent months. Although these recent developments do not meet the specifications as set forth by our advisory group, it should be borne in mind that our specifications were designed to cover as wide a range of conditions as was felt practicable and on a rather long-term basis. For example, the Bureau of Mines' figures for 1946 indicate only one-third of the coal produced in this country came from seams under 42 in., yet we are attempting to evolve a machine to mine 28-in. coal. In addition to their immediate substantial contributions, I believe these recent developments will accelerate the necessary work to achieve the other elements of continuous mining.

The Continuous Miner

By **J. J. Snure,** Production Manager
Rochester & Pittsburgh Coal Co.

THE Joy Continuous Miner has two fundamental parts—the cutting and loading head and the conveying element. The cutting and loading head is composed of six standard cutting chains which run vertical to the coal seam and has an overall width of 30 in. It has a vertical movement of 64 in. from bottom to top; a horizontal swing of approximately 16 ft from rib to rib, and also a forward movement of 18 in. without moving the main chassis of the machine. All movements of the head are hydraulically controlled except the cutting chains which are driven through speed reductions of two 65 hp motors.

The conveying element consists of a short intermediate conveyor working directly behind the cutting chain discharging into a hopper. A chain conveyor takes the coal out of the hopper to the discharge end of the machine; this conveyor may be swung right or left approximately 45 deg. The entire machine is approximately 25 ft 6 in. long and is moved on a separately controlled caterpillar chassis. It weighs about 16 tons. Chain speeds are relatively high; cutting chains run about 500 fpm and conveyor chains about 200 fpm.

Two shuttle cars work behind the machine, both are standard Joy types, but the discharge end of one has been lengthened 24 in. This longer car is used as a surge bin behind the miner while the other is the transportation car. In operation the miner rips the coal from the face and loads it into the surge car. This is accomplished by the following cycle:

With the head in the retracted position, the machine is advanced on its tractor until the cutting bits are just touching the face in the middle place. The head is then swung to its limit at the right and dropped until the bits are just touching bottom rock (or where bottom is to be made). Then, with the cutter chains running, the head is extended or sumped forward 18 in. into the solid coal and at the completion of the sump is raised vertically, shearing out coal until the roof line is reached. It is then retracted to its starting position, cutting loose whatever coal may be left on the roof.

The Continuous Miner in action

Getting the coal away from the miner is accomplished by using two shuttle cars. One has an extended discharge and is used as a surge bin so the miner can continue to operate while the coal is being hauled to the belt. The other is a standard cable reel car hauling approximately three tons per trip to the belt. Fifteen consecutive flights have been removed from the discharge chain of the surge car in order to eliminate spillage at the transfer point from surge car to haul car. This also permits the miner to continue to work while the transfer is being made. In 45 in. of coal, positive synchronizing of hauling and loading can be assured under 225 ft. With more than this distance, the miner may have to shut down—awaiting the return of the haul car with the waiting time increasing as the length of the haul goes up. Rooms should be set so that the haul car makes a minimum number of curves in a trip. Two shuttle car drivers are necessary—one on each car.

Mr. Snure then described the details of their continuous mining system covering ventilation, dust allaying, roof control, manpower, production and safety.

In conclusion I would like to make the following observations: Within 7-10 years most all coal will be mined by a machine which cuts and loads without the necessity of drilling and shooting. The exception may be mines having a preferred market or exceptional physical conditions or properties mining large-sized coal for a domestic market. Even these properties will gradually change over in the future.

During the war the off-track equipment was the saving factor in allowing the mines with a shortage of manpower to furnish national industry sufficient fuel and assist the companies whose mines had less favorable physical conditions to stay in business and make a fair profit. Today the Continuous Miner or similar equipment is going to do the necessary job, only this time the struggle will be for economic self-preservation.

The Colmol

By C. H. Snyder, President
Sunnyhill Mining Co.

THE Colmol, which can best be described as a giant mole, drives a 9½-ft face in one operation, taking the place of the conventional cutting, drilling and loading machines. No shooting is required. It moves forward on caterpillar tractors under its own power, advances the face continuously and may discharge a constant stream of coal onto a gathering conveyor, or other mine transportation equipment. It may produce upwards of 100 tons per man day and a room approximately 9½ ft wide in coal 4 ft high has been advanced at a rate of 18-24 in. per minute. The mine floor is cleaned up and less than 1 percent of the coal is left in the outer corners of the room.

The Colmol is operated by a series of rotary chipping heads, each having widely spaced and progressively receding teeth that chip the coal in overlapping annular concentric kerfs, causing the coal to be freed from the solid face and break out ahead of the teeth. The rotary heads also function as paddles to sweep the floor of the mine in cooperation with a floor shearing blade. The coal from the face is swept to a conveyor which carries it up and to the rear of the machine where the coal may be delivered to a continuous conveying or other transportation system that may carry it out of the mine to the tipple or washing plant.

The widely spaced radial teeth on each of the chipping heads are not only progressively receding from the center of rotation but they are also connected by rearwardly sweeping sharpened edges that remove the coal if it has not been previously chipped free of the face ahead of the teeth. This method of overlapping rotary chipping heads takes advantage of the cleavage structure of the coal, causing much of the coal to break free from its natural state ahead of and without contact with the chipping teeth. This prevents excessive bugdust and produces a low percentage of fines. Some dust is present at the face, but an automatic water spray produces a mist that precipitates most of the dust that might be formed. The sweeping action of the rotary cutting heads which cooperate with the floor shearing blade cleans the mine floor as the machine progresses.

The forward speed of the tractor travel determines the feed of the chipping heads into the coal and is infinitely variable. Increasing the speed of the feed, which increases the pitch of the helix of the teeth of the rotary heads, will produce the coal in larger lumps; if these become too large, the rotary will crush them and a uniform product remarkably free of bugdust or fines and with a controlled top size results.

Its practicability is illustrated by the fact that the cutting head which cuts a fact 9 ft 6 in. by 4 ft operates on less than 100 hp, and the entire machine utilizes a total of less than 120 hp. It has successfully operated in areas containing the hard Pittsburgh seam coal of Allegheny County, Pa., in the soft Upper Freeport coal in Preston County, W. Va., and in the Middle Kittanning coal which contains numerous large sulphur balls, a 6-in. hard slate band, bone coal, and binders. It should operate successfully in the entire range of bituminous coals from those of soft, friable nature to and including those of the hardest structure. It has been operated successfully in shale.

Various mining plans have been considered, but we do not yet know the best way to utilize the machine in actual practice. We have successfully operated the conventional room and pillar system driving off rooms at a 60-deg angle from the entries which are widened at point of room neck. We are at present mining the Upper Freeport seam at Masontown, W. Va., where we are turning roofs off of 14-ft entries at an angle of 45 deg without widening opposite point of room neck and without delays. It will lend itself to long-wall mining where roof conditions will permit. Suggestions have been advanced that rooms may be eliminated and a series of entries driven so that all mining is done parallel to original entry.

Production under widely varying conditions may well result in many new mining plans and, likewise, novel and speedy methods of timbering will doubtless be developed. We have, for example, developed a new system of cross timbering wherein two men can cross timber at the rate of approximately two feet forward advance per minute. Service haulage is also a factor; the machine may produce 500-1000 tons and over per shift, but to accomplish this, mobile conveyors or other new transportation means will need follow the unit. A foreman who may stay with the machine constantly, the operator and two timbermen, making a total of four men, should be all the manpower required at the face.

Recently two mine inspectors who spent a couple of days with our operation were much taken with these safety features: the soundness of the roof, because of no shooting or excessive vibration; the strong uniform ribs left in its natural state with an arch at the top which provides great roof support; the clean-up with almost complete elimination of loose coal; and the location of the operator 20 ft back from the face. In our production unit the operator will probably be provided with a steel canopy which is capable of holding a 30-ton roof fall in an area the size of his body.

The machine is operating daily at our Masontown, W. Va., mine in the Upper Freeport seam, which is approximately 48 in. thick. Despite the fact that present transportation facilities (shuttle cars) will take the coal away from the unit at a speed which will permit average operation, one minute out of four—it is not operating three-fourths of the time—we have still produced over 400 tons in a shift of only slightly over seven hours' working time. We have advanced an 80-ft crosscut, 9½ ft wide, in less than an hour and thirty minutes total elapsed time.

The Colmol as recently introduced to the coal industry

Belt Conveyor Loading

A Report of the Convention Committee

Shuttle Car Loading for Belt Conveyors

By **V. D. Hanson**, Mechanical Engineer
Pittsburgh Coal Co.

A BELT conveyor is solely a transportation unit and as customarily used for gathering service, is installed in an entry, delivering coal from the room necks to the main haulage, which may be a trip of mine cars or a main conveyor. In a mining system of this type, the loading at the face may be by hand shoveling onto a face conveyor or by mechanical loading into a conveyor or a shuttle car, but in either case the room unit, whether conveyor or a shuttle car, serves as a link between the face and the entry belt. If the belt is to operate successfully, it must be loaded properly by this room unit and the success or failure of belt transportation—operation and maintenance—is to a large degree affected by the way in which the belt is loaded.

When a conveyor is used from the face to the room neck, the transfer is somewhat simple, although the feed onto the belt must of course be regulated to suit the belt-carrying capacity, and where several room units are in simultaneous operation, considerable care must be exercised to prevent overloading and spillage. In addition, there is a problem caused by an abrupt change in direction and velocity of the flow of the coal from one unit to another.

When the belt is loaded by shuttle car, the problem becomes more complicated. The shuttle unloading rate is much greater than the usual belt capacity, and when the shuttle loads directly onto the belt, either the shuttle discharge must be slowed down, which causes an undesirable delay, or else the belt speed must be increased. A third plan is to have indirect belt loading by using a "surge" hopper or conveyor between the shuttle and the belt so that both can operate at normal rates.

An Automatic Hopper

An original belt loading device, of homemade design and construction, is used by our company for shuttle cars in a room panel which has in the entry a 30-in. gathering belt conveyor, 1800 ft long running at a speed of 160-240 fpm. In this panel, rooms and pillars are mined with a tractor-mounted loading machine; the shuttles operate between the working faces and the room necks and as several places are worked simultaneously, it is necessary to have a number of separate belt-loading stations on the entry. At the beginning, several attempts were made to load the belt with chutes; these varied from fixed position plates through cable suspended chutes but all proved unsatisfactory, with crowding and spillage.

To overcome these undesirable features, an automatic hopper was designed by our company. This is an open-end hopper of steel construction which straddles the belt and is approximately 7 ft long, 4 ft wide at the top with the sides sloping down to a bottom opening 14 in. wide by 7 ft long which centers on the belt. Through this opening the coal drops onto the belt which acts as a self-feeder to empty the hopper.

Another mine uses belt feeder to speed up the transfer of coal from shuttle car to belt conveyor. Due to the large capacity of the feeder hopper, the shuttle car can take full advantage of its high unloading speed. Seconds after reaching the transfer point the shuttle car is on the way back to the loader, while the belt feeder moves the coal slowly and evenly onto the conveyor. Excessive belt wear from uneven load distribution is eliminated.

The chain type feeder consists of three sections: the ramp, the sliding carriage, and the elevated discharge. This is built to handle shuttle cars with capacities up to six tons, and a larger model is available for cars up to ten tons in capacity. The shuttle drives up the ramp onto a sliding carriage which takes the front wheels to the forward end of the hopper. The car discharges its load, backing out as the front of the hopper fills up. A chain conveyor in the bottom of the hopper slowly empties the load onto the belt. Discharge height is adjustable.

The paper then describes several installations with shaker feeders and concludes:

In conclusion, we would like to point out that due to the many factors involved, the final choice must be predicated on the number of units discharging on the belt, the rate of discharge, capital investment required, and the capacity of the belt in terms of production desired.

Loading Belts Through Transfer Serge Conveyors

By **C. W. Thompson**
Weirton Coal Co.

SHUTTLE cars loading directly on belt conveyors create a number of problems that must be effectively handled to insure long belt life. The first and foremost problem involved is the one of dumping ROM coal onto a belt conveyor at a slow rate of acceleration as compared with the high rate of belt speed which is needed to receive coal from a shuttle car at 5-10 tons per minute. This method of transferring coal from shuttle car to belt conveyor introduces a high rate of abrasive wear. Cutting and gouging appear quite frequently with this method with subsequent rupturing of belt carcass. Spillage of coal onto the belt decking along the entire length of belt conveyor becomes quite common with direct loading. This spillage, even in the best supervised mines, is allowed to accumulate until portions of the belt are dragging through coal and rock.

The following outlined problems are apparent with direct loading:

(1) Carcass rupture from impact
- (a) Caused by large lumps of coal and pieces of rock dropping directly onto belt

(2) Cover wear from abrasion
- (a) Caused by scuffing when coal and rock are loaded onto belt at slower rate of speed than belt is traveling
- (b) Also caused by belt dragging through coal spilled on belt decking along conveyor line
  - (1) This is a serious matter inasmuch as edge wear becomes highly probable at this point. Edge wear is the quickest route to belt mortality.

Economic considerations show that in an average mine employing a number of belt conveyors where shuttle cars are used, large savings can be realized whenever the aforementioned problems are eliminated. For instance, doubling the life of a belt in such a mine will at times net a saving of approximately $60,000 in five years where only 20,000 ft of conveyor belt is used. Add to this figure the savings in labor cost needed to clean along belt line where direct loading is done and you reach a figure nearer $130,000 for the five-year period.

C. W. Thompson

One solution to these problems has been found after many years of experimentation. The following outline illustrates the pattern of advances and the final culmination of ideas:

One twin-driven, heavy-duty chain conveyor receives coal or rock from a shuttle car. This conveyor has a number of hopper stations along the conveyor line that provide miniature bins at such points and permit rapid unloading of shuttle cars. Coal is piled high at these locations but is held back by plows attached to the sides of the conveyor hopper so that coal will not spill off of the chain conveyor where hopper plates are not attached. The use of several hopper stations makes shuttle car unloading flexible inasmuch as each shuttle car has its own unloading station. This conveyor can be extended to 350 ft and has a 25 hp drive on each side to keep the over-all height down to 30 in. and to provide stability at the head of the conveyor. This conveyor handles coal at 5 TPM and re-

ceives coal from the shuttle car at the rate of 10 TPM, this being made possible with the use of the hopper stations.

The heavy duty conveyor dumps into a short, flat chain conveyor which accelerates the coal speed to 450 fpm. This intermediate conveyor receives the coal from the longer conveyor and absorbs shock and in turn lowers the coal to within 4 in. of the top of the belt conveyor. Spillage is eliminated as cascading is at a minimum because of the small drop between the intermediate conveyor and belt conveyor. By the same token, carcass rupture is eliminated. Accelerating the coal speed to the belt speed horizontally rather than vertically not only eliminates the need for pneumatic idlers, but at the same time causes abrasion to disappear. Visualizing the over-all picture, we see coal being loaded from any height at 10 TPM from shuttle car to heavy-duty chain conveyor, transported to belt conveyor at 5 TPM and loaded onto belt conveyor by intermediate conveyor without vertical drop and at belt rated speed.

Belt Conveyor Loading with Shaker Feeders

By **A. B. Crichton, Jr.**, Assistant to President
Johnstown Coal & Coke Co.

COAL mining today almost resembles an assembly line industry. This is true with respect to supervision, the method and cycle of operations performed at the face and the system of transportation of the product.

Once coal is broken down at the face, the subsequent job is entirely one of transportation. In a modern mine using belt conveyors for primary haulage, coal is always in motion in some or all sections during the operating shift. Only one word adequately encompasses proper and efficient belt conveyor haulage and this is "synchronization." To properly accomplish simultaneous or coincidental movement of material we are unavoidably concerned with its rate of flow. Daily or hourly tonnage requirements, from which are calculated belt widths and belt speeds, keep this rate of flow confined within definitely predetermined limits. Conformation to this rate requires flow regulation. A shaker feeder is a regulator.

The shaker feeder is an intermediate mechanical arrangement that transfers the run-of-face product from a shuttle car to a belt conveyor at a measured and controlled rate. This individual unit consists of a conventional shaker-type drive with a conveyor lagged pan line to which is attached a shallow lagged hopper or surge bin. An initial set-up extends about 45 ft inby the belt conveyor tail pulley. As the faces advance, crosscuts through which shuttle cars can travel, connect the belt heading with outside entries. By the insertion of additional conveyor pans between the shaker drive and the hopper, the hopper can be kept at a location just outby the last crosscut. This keeps shuttle-car travel distance to an absolute minimum. When the shaker feeder unit is extended some 150 ft or to the distance that has been established for a belt conveyor extension, the feeder unit is "knocked-down," the belt is extended, and the feeder unit is re-installed and reduced to its original short length.

Coal is unloaded into this hopper at the shuttle car's maximum discharge rate, the discharge time of a two-ton capacity car is approximately 20 seconds. This is at a rate of 6 TPM or 360 TPH. For discharge to the belt, the feeder unit is adjusted to approximately 1 TPM or to a flow rate in proper proportion to the total tonnage fed to the main line belt.

Advantages to be realized by the controlled feed are as follows:

In mining low coal between 36 and 50 in. high, where belt conveyors and shuttle cars are the means of transportation, roof holes or "duck's nests" are not required for clearance between shuttle cars and the roof where timber ramps are used to elevate the cars for direct discharge of coal to the belt.

Continual stopping and starting of belts which greatly reduces belt life is seldom necessary with shaker feeders.

With feeders, longer belt life is also realized because much scruffing action is eliminated where coal is fed to the belt. Coal is put in motion in the direction of belt travel by the feeder. A direct discharge to the belt from a shuttle car at or near full belt capacity increases scruffing as the coal hits the belt at right angles.

Dust at transfer points is greatly reduced as spray systems are more effective on a continuous light flow.

Proper regulation of flow eliminates spillage along the belt lines at discharge and transfer locations and at confluence points.

With regulation of flow, some coal is passing through the tipple at all times. This provides a better opportunity for cleaning, hence a more uniform product. The efficiency of both manual and mechanical cleaning is at a maximum. When carrying some load, the vibration of all moving parts and the entire tipple structure is greatly reduced.

Manufacturer's Recommendations for Belt Loading

By **Robert Fletcher**
J. H. Fletcher Co.

AS a part of the discussion of "Shuttle-Car Belt Conveyor Loading Points," a number of belt and conveyor manufacturers were asked for their recommendations of good loading point practice. From replies received, the following has been compiled:

(1) *Avoid overloading:*

The tonnage that can be handled by a belt conveyor is dependent on belt width, speed, and size consist of material. When more material is loaded than the belt can take away, spillage occurs about the loading hopper, often resulting in damage to the belt.

Overloading is most frequently of the surge type. An auxiliary feeder between the shuttle car and belt, or controlled shuttle car feed, tend to even the flow.

(2) *Regulate Speed:*

Too great a difference between speed of belt and feed may result in spillage at the loading point. This is accentuated where loading is 90 deg to the flow of belt, and material must make a directional change. Auxiliary feeders should discharge the material to the belt conveyor in line with the conveyor.

(3) *Cushion Impact:*

Height of discharge above the conveyor should be held to a minimum, and is particularly vital where large lumps or impurities are a part of the load. Special steps should be taken to cushion the impact. It may be possible to screen fines onto the belt through a bar chute so that lumps slide onto a coal bed. There are also several designs of idlers which absorb shock. Where these are used they are generally spaced on close centers. Other methods eliminate idlers completely, or a cushioning belt is used beneath the main belt. It is, however, generally considered poor practice to permit impact on standard steel idlers.

(4) *Align the Material:*

Material should receive proper alignment on the belt through hopper or skirt boards. Distance between skirt boards should approximate 75 percent of belt width, and be slightly greater toward the outby end to decrease the possibility of lumps lodging in the throat. Board length should be a minimum of four times belt width.

Approximately 2 in. of flashing should be attached to the bottom of the side boards so there will be rubber contact with the belt. Flashing should be adjustable to take care of wear. A solid rubber flashing is advisable rather than strips of belting, as the duck in the belting will pick up sharp particles which will score the belt. At the side loading points, definite effort should be made to place the material in the center of the conveyor, so that the belt will run true.

(5) *Use Common Sense:*

There are many other precautionary measures that may be taken. Bumping blocks should be placed so a shuttle car will not hit a loading point. There should be adequate lighting. Any loading point will require periodic cleanup. Occasional adjustment is necessary.

Safety control devices may be installed that will stop the conveyor if the hopper jams, if belt moves too far to one side, or the tail shaft breaks.

Belt conveyors are flexible units that can be adjusted to varying mine conditions. Given ordinary consideration, satisfactory "Shuttle Car-Belt Conveyor Loading Points" may be easily installed and readily maintained.

The foregoing reports on belt loading were prepared and presented under the direction of A. E. Long, production superintendent, Clearfield Bituminous Coal Corp., Chairman of the Coal Division Committee on Conveyor Mining.

Haulage and Hoisting

Locomotive Trip Dispatching by Telephone and Radio

By **Frank Eubanks**, Superintendent
Mechanical Maintenance Underground
Old Ben Coal Corp.

AN important factor in cost reduction is a transportation system that stays well ahead of cutting, drilling, and loading—but it must stay ahead with safety! You may have the best tracks, the best cars and motor available, and still not have efficient production. To get the most out of your transportation system the trips must be kept rolling!

Stops are expensive. They increase wear and tear on rolling equipment, besides wasting time. It has been estimated that the average stop will consume roughly two minutes—a trip would be advanced 1800 ft in two minutes—ten miles per hour if that stop were eliminated. Just consider what your main line stops are costing for time lost to call the dispatcher, to throw switches, and to wait for an opposite-bound trip to pass to give a clear track ahead. Delays cost money and it is money needlessly spent in many instances, because there are few stops that are actually necessary with proper haulage control.

The answer to increased demands on a haulage system is not necessarily adding another motor or more cars. There are instances where increased demands have been handled with *less* rolling stock, and consequently less manpower through the use of proper haulage control equipment. It is a fact that many installations of automatic block signals and electric track switches have paid for themselves in the first year through increased production and other savings they effected. Furthermore, this has been done with less accidents. One average wreck would pay for a lot of signals and electric track switches in actual money spent for repairs and in time lost, to say nothing of human suffering and death.

The usual procedure in directing motor traffic is to require all motormen to come to a stop at each passing track and call the dispatcher for clearance. They are also required to call before leaving the bottom with empties. These calls are made by telephone and they obviously require a considerable amount of the motormen's time.

The need for communication, including both telephones and light signals, is well understood by all who are engaged in mining. As soon as even one locomotive is used, the motorman must be given instructions from time to time. As the number of locomotives increases the problem of communication, by one means or another, or by several means, becomes increasingly complex. Signal lights must be used to warn other motormen that certain sections of the track are occupied, and telephones must be located at several vital points so information can be passed from motorman to dispatcher, and dispatcher to motorman.

Under normal conditions the dispatcher is informed by telephone as to where the motorman is, whether he is ready to leave, and what trouble he may be in. The dispatcher then tells him what he must do. All this works well while conditions remain normal, but conditions never remain normal very long in a coal mine.

Phones placed at closer intervals help this situation somewhat, but a little thought brings us to the conclusion that the only proper answer is to have the phone on the motor itself, so the motorman is in touch with the dispatcher and with other motormen at all times.

To solve this problem, we at Old Ben began an investigation about two years ago of a communication unit which the builders claimed would provide continuous two-way conversation between traveling motors and from traveling motors to the dispatcher. This unit, known as the FEMCO Trolleyphone, looked good to us and we decided to try it in our No. 11 Mine at Christopher, Ill.

As soon as these Trolleyphones were installed we were able to move three trappers to other, more productive jobs. Then, other advantages were brought to light. All motormen running the same track knew for sure where the other motors were, and felt more confidence as they came around the turnouts. They helped each other, in that each man could report difficulties immediately and ask for help when he needed it. When one section was having a good day and loading an unusual amount of coal, and another section was having difficulties, the empty trips were quickly rerouted and more cars sent to those who needed them.

The net result has been that while during the past year the average length of haulage in this mine has increased by about a mile and a half, the same four motors are still pulling the coal. Moreover, a large section of track that used to form a necessary loop has now been taken up and that part of the mine sealed off. This more efficient method of motor haulage control has actually enabled us to run four motors over a section of single track that could formerly handle only two motors, and the trips are made faster than before.

The FEMCO Trolleyphone equipment consists essentially of a transmitter and receiver, a loud speaker, a microphone and a resistor for reducing the trolley voltage for the tube heaters. The transmitter-receiver is contained in a single chassis, and is provided with dust-proof covers. The whole assembly is cushioned on rubber, and slides into a heavy steel housing.

The power for the Trolleyphones is taken from the trolley itself and the signal is carried by the same wire. Communication is maintained between all points connected by the d-c system used in the mine. Whether the phone is mounted on a moving motor or is located at some fixed point such as the mine manager's office, or on a section near the face boss, makes no difference. When anyone presses the talk button on a microphone and talks into it, his words are carried throughout the mine and reproduced by every loud speaker.

The man to whom this message is directed can reply by talking into any other microphone, and his words also are carried to every point in the system. This has the effect of bringing all personnel closer together. If several people are interested in the same thing, they can all talk together—but, of course, only one man can actually speak at a time.

None of the Old Ben mines have an elaborate system of double track, intricate railroad signals for high-speed, main-line motors; therefore, we believe our haulage problems are similar to those in most coal mines. Our experience has brought us to one conclusion: For better and increased production, for improved over-all efficiency and for much greater safety we are convinced we must base all our future haulage planning on making use of the most complete form of mine communication that we know. We believe that we owe this to our men, for in our opinion there is nothing more practical that we could do to promote safety in our mines. We believe we also owe it to the management who have every right to expect us to employ the most modern productive methods for getting out coal.

Latest Developments in Belt Haulage

By **Carel Robinson**
Robinson & Robinson

Mr. Robinson's paper will appear in full in the July issue of MINING CONGRESS JOURNAL.

Shafts vs. Slopes for Hoisting

By **Paul Weir**, President
Paul Weir Co.

DURING the past 15 years there have been a number of slope belt installations in this country for raising coal to the surface from seams which lie below drainage. Three major factors have given an impetus to such installations. First, mechanical mucking in the sinking of slopes having an inclination of less than 18 deg has reduced the cost as well as substantially reducing the time required for sinking. Second, the manufacturers of con-

veyor belting have developed a product that permits a three- or four-fold increase in the vertical distance through which coal formerly could be raised on a single-run conveyor. Third, the growing use of belts for underground transportation has familiarized operating personnel with its efficient installation and use.

Generally, this paper is concerned with the assumed development of a new mine and will not touch upon the substitution of one form of raising coal to the surface for another at an existing mine. This latter is a special problem.

Mr. Weir, after a general discussion of the functions of slopes and shafts then considered each type in detail. He covered general plans, the effect of depth and length, the cost of sinking and lining, and the equipment needed for each class installation. His paper concluded with comparisons as follows:

Comparison of Utility

With the possible exception of raising mine rock to the surface, the advantages are with the slope. The usual units of underground equipment can be handled on the slope without dismantling. Likewise, there is no limitation on the lengths of rail and timbers that may be taken underground without added expense.

The degree of interference in handling mine rock is largely a product of the quantity that must be raised to the surface. If such rock can be handled off-shift and provided that the conveyor belt is of sufficient width to handle the largest pieces, then no disadvantage results. Otherwise, the skip has the advantage.

If mining is pursued in more than one seam, the slope has a distinct advantage.

Operating Comparison

Labor Force

Comparison of labor starts with the feeder to the conveyor belt and the skip loaders, which are automatic. Ahead of these points there should be no difference in the labor forces attributable to the means for raising coal and/or rock. There is, of course, the opportunity for a completely automatic skip hoist with the operation of the hoist controlled from the shaft bottom by the rotary dump operator. However, some attendance at the hoist would be required but probably no more than that accorded the belt conveyor by a patrolman and greaser. We do not mean that all present skip operations are so set up. Rather, we see no reason why they cannot be.

In the handling of men, materials and equipment on a slope, the hoist operator may or may not be a full-time engineer attached exclusively to that job. In the case of a shaft he probably would be.

There should be little, if any, difference in the labor cost of handling ordinary materials and supplies to the shaft or slope mouth and on the shaft or slope bottom. Of course, if the dimensions of the shaft are such that equipment must be dismantled to handle it through the shaft, extra labor is required. This would probably be occasional rather than usual.

The advantage is with the slope but the difference can be held to an average of probably not over one or possibly two men per shift.

Maintenance

A well-designed and well-installed skip plant should operate with no more maintenance than there would be on a belt conveyor. With the exception of hoisting ropes, the life of all items in the case of a skip plant should exceed that of the belt. Of course, there may be accidents. This happens to belts, too.

Power

The advantage is with the belt, the over-all efficiency of which approximates 75 percent. In addition to this, there is an advantage in the demand charge for power.

The over-all efficiency of a skip hoist may vary from 35-55 percent. If we assume an efficiency of 50 percent, the kilowatt-hour consumption per ton for an equivalent vertical lift is 50 percent greater than for a belt conveyor.

On a 500-ft vertical lift the kilowatt hour per ton would be approximately 0.50 for a belt conveyor and 0.75 for a skip hoist. However, it should be pointed out that at shallow depths there is little or no full-speed operation in the middle of the shaft. Acceleration goes directly into retardation. As the height of the lift increases and there is an interval of full-speed operation between acceleration and retardation, the efficiency of a properly designed unit increases.

The power consumed in handling men, materials, and equipment should be the same for the slope as it is for the shaft.

We do not believe that the full possibilities of skip hoisting in vertical shafts are being given due consideration. Improvements in shaft sinking are progressing and fully automatic hoisting is with us.

The use of air locks over shafts is not common in this country. However, in the United Kingdom this practice is followed extensively.

Two other practices may have some application at shaft operations. Man-riding on a deck built into the skip bail is practiced to a limited extent in this country. Wire rope guides are in almost universal use in the United Kingdom. There may be some economies in their use in this country, particularly in circular shafts which are used for coal but not for man-riding.

The depth at which skip hoists become more economical than slope belt conveyors is dependent upon a number of variables. We have called attention to the principal ones. The question of hourly capacity certainly exerts an influence. Each specific installation must be carefully analyzed. Snap judgment and personal preferences are no substitute. Certainly all of the various services to be performed must be included in any analysis, which must consider capital costs as well as operating and maintenance costs.

Maintenance

Inspection, Repair, and Maintenance of Underground Equipment

By **W. F. Diamond,** General Superintendent Marianna Smokeless Coal Co.

THE Marianna Smokeless Coal Co. operates two mines in Wyoming County, in southern West Virginia. These are both drift openings in the Sewell seam which has a mining thickness of 28-40 in. over this property. The two mines are completely mechanized, having a total of 20 Goodman shakers with duckbills, seven 30-in. troughed belt conveyors, and 24 shortwall mining machines.

Each mine employs one electrician on each shift. These men work out of a small repair shop which is maintained at each mine near the drift mouth, and is equipped with such repair tools as a brazing and cutting torch, a welder, a vice, a drill press and bench grinder. Storage bins and racks are provided for the most commonly used small repair parts. Attached to the shop building is a small storage shed in which spare equipment and the larger assemblies are kept.

Supplementing the maintenance and repair facilities at the two mines, there is a main shop in which all the major overhaul and repair work is handled. The shop crew, consisting of two electricians, an electrician helper, a welder and a blacksmith, are all under the direction of a chief electrician. The building is equipped with a lathe, three drill presses, a milling machine, band saw, two welding machines, cable vulcanizer, pipe and bolt threading machine, three bench grinders, an overhead traveling hoist and three cutting and brazing torches. Attached to the main shop building is a combination welding and blacksmith shop.

Near this shop is a large warehouse in which is carried a complete stock of repair parts for the various pieces of underground and surface equipment. All parts are cataloged by part number and stored in bins. These parts are grouped according to the equipment upon which they are to be used and a complete card file and perpetual inventory is carried on each item in stock. Two men, a warehouse man and a supply clerk, work here handling the requisitioning of supplies from the purchasing department, their receipt, storage, and disbursement. A charge is made for each item leaving the warehouse as to which mine requisitioned the supply and upon what equipment it is to be used. These charges are furnished the accounting department daily and are used in making up the daily and monthly supply cost.

Haulage underground is a combination of belt and track with the belt conveyors being used in the butt entries. No track is laid beyond the belt booms, the men and sectional supplies being handled by operating the belts in reverse. Because of the low seam height and the fact that the actual face equipment is always some distance from the track, all repairs except major breakdowns, such as badly broken frames, damaged bearing fits or bearing housing fits in the frames, are made in place.

Mr. Diamond's paper then discusses in detail the essential factors in belt conveyor maintenance and also describes methods of making belt splices. He especially stresses maintenance procedure for face equipment, such as cutting machines, shaker drives and pan lines. He continues with a coverage of their methods for lubrication and inspection as follows:

No discussion of machine maintenance would be complete without a reference to the importance of proper lubrication for this cannot be overemphasized. We make one person responsible for the work whenever possible. All motor bearings are ball bearings with shaft seals, including those on the belt drives, shaker drives and cutting machines; these are greased once a month. The electrician is responsible for these bearings and, insofar as possible, attempts to grease them on the same day each month. On the cutting machines the sheaves, control levers, planetaries, friction, and clutches are oiled by the machine operator each shift, and the effectiveness of this lubrication is checked by the electrician on his daily inspection. The greasing of all other bearings such as the bushings on the shaker drive and side drive attachment, and operating shaft on the duckbills is the responsibility of the greaser. These are all greased twice a day in shift. This man also checks daily and maintains the proper oil level in the shaker drive cases.

To aid in preventing breakdowns and to help correct defects before they become breakdowns, the operators of the machines are instructed in the proper operation of the equipment to prevent overloading and stressing. Working sections are composed of two working places under the supervision of an assistant foreman which gives close supervisory control, and since all sectional supervisors were upgraded from the face crew, and are thoroughly familiar with the operation of the equipment on their section, they know how it should be handled.

Any adjustment or required repair detected by an operator is relayed to his foreman who in turn tells the electrician. This request is passed on to the electrician verbally and is confirmed in writing on the bottom of the foreman's daily operating report where space has been provided to indicate any needed repairs to the machines or junction boxes on his section.

An effective maintenance setup hinges upon several factors, all of which are highly important. These include: (1) Daily inspections of the equipment to minimize the occurrence of major breakdowns that result from the non-detection of contributing minor failures. (2) The maintenance of plenty of spare equipment and repair assemblies near the center of operation so that they will be quickly available in the event of a breakdown. (This is especially true in a thin seam conveyor mine where the moving of equipment for repairs is slow and costly.) (3) The scheduling of regular and complete overhauls to maintain the equipment at or near factory specifications, coupled with the maintenance of facilities and supplies to handle these overhauls. (4) The proper application of lubricants in both quantity and quality to prevent the wear caused by metal-to-metal contact. (5) A program of operator training designed to eliminate the abuse and overloading of the equipment. (6) The preparation of reports each day to show what equipment is being inspected and what repairs were made or needed. (7) And last, but of course not least, the compilation of accurate cost figures so that the amount of money being spent on the various pieces of equipment for parts and labor is always known. This is really the "'proof of the pudding" for these figures give a measure of the effectiveness of the maintenance program.

Trailing Cables for Face Equipment

By **C. C. Ballard**, Mechanical Engineer
The New River Co.

TRAILING cables for face electrical equipment in coal mining has grown to be an important factor in present-day mining systems, with use of shuttle cars, mobile loaders, conveyors of different types, continuous loaders, drills, etc.

Trailing cables are subject to severe use and should stand up under twisting, bending, stretching, run-overs, acid, mine water, mud, abrasion, and many other conditions. These conditions make a specially designed cable important to the industry, as to safety to the men handling these cables.

We, the operators, realize that we can never hope to obtain a trailing cable that is absolutely perfect. We also realize that our manufacturing friends cannot ever approach the perfect cable unless we advise them of our needs. We are glad that we are using the cable instead of designing it, because that must be an enormous job.

What do we want in a trailing cable?

(1) Light in weight and very flexible for ease in handling (Had you realized that 350 ft of No. 2 parallel duplex with ground wire weighs 418 lb?)

(2) Must be resistant to water, oil, and severe mechanical abrasion

(3) Must have a small diameter to save space in spooling

(4) Must be capable of severe bending, twisting and strains. In other words, it must have strength of hard drawn copper with workability of soft drawn

(5) Colors of conductors should conform to American Mining Congress Standards

(6) Cables designed for off-the-track equipment should carry safety ground wire of sufficient size to remove all hazards resulting from ground failures. Cables with ground wires should be so constructed as to afford good mechanical protection for the conductors, and especially for the ground wire

(7) Cables for off-the-track equipment should have a design which will lessen the chances of cable damage when the cable is run over

(8) Have design engineers develop a splice that will eliminate over-sizing and conductor failures after very few flexings.

Whether or not drill cables may be termed as trailing cables I do not know, but I do know, and my committee feels that portable drill cables are more important than most operators admit.

Drill cables—workmen pull drills with cables, throw tools and machinery on the cable, thereby cutting and stretching the cable beyond its safe limits. It is a known fact that three-conductor drill cables having size No. 12 conductors, have been pulled and stretched under working conditions so that the cross-sectional area of the conductor was reduced to that of a No. 14 conductor. Such a condition is typical of the severe uses to which trailing cables are subjected in mines.

The points that have been mentioned in trailing cables are certainly applicable to this type of cable. The personal hazards are more important with this particular cable than they are with so-called trailing cables.

(9) Cables must be resistant to flames and when subjected to flames should not give off obnoxious or dangerous gases.

(10) The cable jacket must be designed so that it will not deteriorate when stored in the warehouse. The cable jacket should be vulcanized so as to tightly adhere to the conductors, thus eliminating the creeping of the jacket after splices have been made. The cable jacket should be so designed that extreme temperature conditions will not blister or crack the jacket.

Our committee realizes that the cable manufacturers have made great progress, particularly in the past few years, in giving us the ideal cable, but of course progress stops when a user becomes completely satisfied. To mention one of the recent changes that some of the cable manufacturers are doing, is the coloring of the cable jacket.

We will make one important request from the cable manufacturers. Your cable is good now. It will be better if more care is exercised in handling the present cable. An advertising program designed to sell all those responsible for the handling of cable, and the proper care of it is being conducted now, to some extent at management level, but it fails to reach the ones who actually handle cable. This is probably our fault, but your job is to help us cure our faults.

Electric Cables for Mine Service; Trailing Cables for Face Operations

By **E. W. Davis**, Chief Engineer
Simplex Wire & Cable Co.

THE mechanization of coal mines has resulted in a great increase in the use of mobile electrical equipment. Not so many years ago, there were only drills, mining machines and gathering locomotives at the face. Today, in addition, there are shuttle cars, loaders, drills, hoists, compressors, blowers, face conveyors, and the continuous miner, all requiring trailing cables. Inasmuch as most of this equipment must operate as a unit, it is of utmost importance that the trailing cable

supplying each individual machine be "adequate" for the service.

The first consideration for "adequacy" of a power cable for trailing service must be the conductor size. Conductor size should be determined first by the current load and then increased if necessary to maintain the voltage drop within reasonable and workable limits. An undersized conductor with heavy current results in overheating of the cable which often is the direct cause of cable failure. This is particularly so for cables handled on machine reels—the part on the reel becoming excessively hot because of the interchange of heat from turn to turn or layer to layer.

The paper then presents tables showing current carrying capacities for various types of cables; one, two, three and four conductors of sizes ranging from No. 8 to 1,000,000 cir mils. The effect of temperature is also explained, showing the difference in the heating effect between loose cable and when rolled on gathering reels. The size of the outside diameter is discussed as follows:

The outside diameter of a cable is largely determined by the number and size of the conductors and for a given number of conductors, this means the size of conductor only. The length of trailing cable that may be wound on a given machine reel depends upon the outside diameter of the cable. Some operators—and I am afraid some machine manufacturers—determine the size of conductor by working backwards from a cable outside diameter which will allow a maximum length to be wound on the machine reel. By this method, a cable with a totally inadequate size of conductor to handle the current is often used. From a cable service point of view, too much stress cannot be given to the fallacy of determining conductor size by this method—even recognizing the need for a maximum radius through which a machine fed by a trailing cable should operate. This is particularly true today when many machines work on extra shifts and at increasingly higher load factors.

For many years, operators have been plagued by the multiplicity of over-all diameters found with trailing cables from different manufacturers, all having the same number and size of conductors and for the same reel service. This made the interchangeability of various makes of cable an impossibility if gasproof fittings were used. Recently, the Bureau of Mines in Schedule 2E (revision) has set up a table of outside dimensions with allowable tolerances to which practically all cable manufacturers of trailing cable subscribe.

The second consideration for "adequacy" of a cable for trailing service is the materials used in its design and construction and how well these materials maintain the essential characteristics under operating service conditions.

In the early days of mine mechanization, major attention was paid to the design, manufacture, and use of the mechanical equipment and too little attention to the electric cables feeding such equipment. In fact, both the operators and cable manufacturers were ignorant of the essential characteristics mandatory to correct cable design if satisfactory and efficient service were to be obtained. The copper conductors were stranded to give flexibility, but the type of stranding was not such as to withstand the stresses of twisting and pulling to which all trailing cables in mines are subjected. The rubber insulating compounds were not adequate to resist crushing, water, and high temperature always encountered in mine service—and the outer coverings were cotton or jute braids saturated with tars or asphalts. These cables had extremely short service life, in fact so short that only first cost was considered in their design.

In 1920, a survey of service conditions pointed out inadequacies of design and materials used in trailing cables prior to that date—particularly the rubber insulation on the conductor and the outer protective coverings. As an immediate result of this survey, there was an almost universal adoption of natural rubber jackets or sheaths with tire-tread characteristics in place of the cotton or jute braids previously used. Immediate improvement of service life for trailing cables was noted. Since 1920 vast improvements in rubber insulating compounds together with the development of hard service Neoprene compound for jackets or sheaths have greatly prolonged the service life, so the first cost of a cable may be relegated to its proper place in determining the "adequacy" of a trailing cable.

As a material, the copper in the conductor needs little discussion in this paper. Up to the present time only pure annealed soft drawn copper has been used. Occasionally, in order to increase the tensile strength of the conductor, a few strands of high tensile steel is included with the copper strands making up the conductor—but this is generally confined to the single conductor cable for locomotive service.

Laboratory work is under way to determine the feasibility of using some of the new copper alloys which may result in higher conductor tensile strength, higher fatigue resistance, higher yield point, etc. Unfortunately, the higher resistivity and the resultant increase of conductor size to handle the current load makes many of these alloys of no value for trailing cables. (The same high resistivity precludes the use of aluminum conductors in most power trailing cables.)

Trailing cables for use at face operations are almost always rated at 600 v or less. At this low voltage, the electrical properties of the rubber insulation are not of major importance except insofar as they are affected by the mechanical abuse to which the cable is subjected. The physical properties of the insulating compound are of major importance—not only the physical properties of the compound when it is first applied to the conductor, but the physical properties when the cable is *at* the high operating temperature as well as after it has been in service for a long period of time. Initial tensile strength and elongation are of importance, but their value after being in service is of even greater importance. It is absolutely essential that the insulating compound be such that it will resist compression and deformation when the cable is subjected to runovers, rock falls, and other mechanical abuse. Such insulating compounds are not of the ordinary run-of-the-mill type, but rather specifically designed to have high resistance to compression and deformation *at* high temperature. Ordinary heat resistant compounds are not adequate, in fact, may not be any better than the performance grade compounds that have been used since the advent of the rubber-sheathed trailing cables.

The paper concludes with a further discussion of insulating and jacket material with tables showing the various physical properties of cables of all types and sizes.

TABLE I. RECOMMENDED CURRENT CARRYING CAPACITIES
(In Amperes Per Conductor)

Portable Rubber Insulated, Rubber Sheathed Power Cable

A.W.G. or M.C.M.	1-Cond.	2-Cond. Concentric	2-Cond. Twin and Round	3-Cond.	4-Cond.
8	45	—	40	35	30
6	60	50	50	50	40
4	85	65	70	65	55
3	95	75	80	75	65
2	110	90	95	90	75
1	130	100	110	100	85
1/0	150	120	130	120	100
2/0	175	135	150	135	115
3/0	205	160	175	155	130
4/0	235	180	200	180	150
250	275		220	200	160
300	305		240	220	175
350	345		260	235	190
400	375		280	250	200
450	400		300	270	215
500	425		320	290	230
550	450				
600	475				
650	495				
700	520				
750	540				
800	560				
900	600				
1000	645				

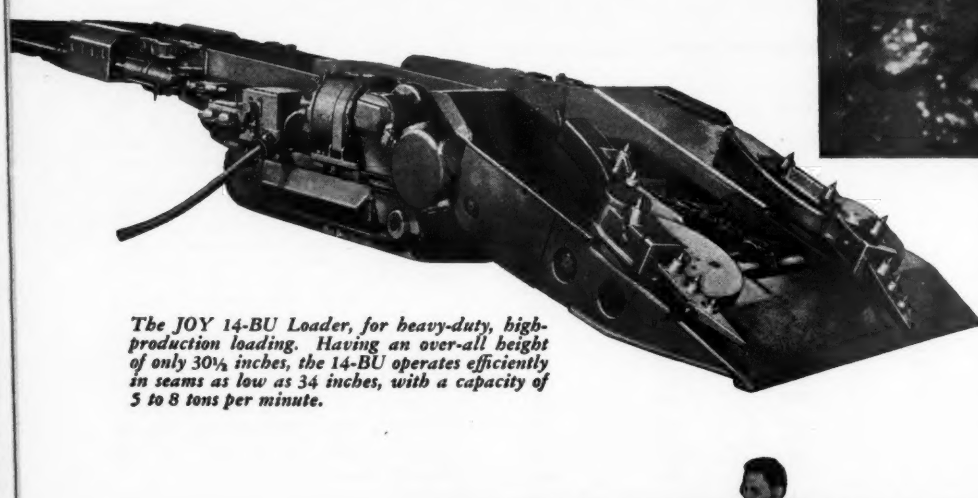
Tractors and Trailers for Man-Trips and Supply Haulage

By **G. O. Tarleton**, Vice-President
Consolidation Coal Co. (Ky.)

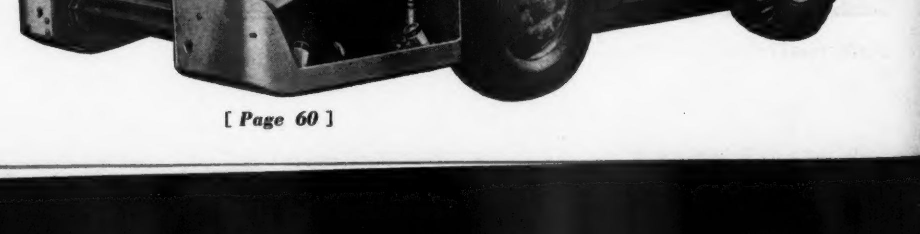
Mr. Tarleton's paper was published in full in the May issue of MINING CONGRESS JOURNAL.

JOY LOADS COAL FASTER!

JOY, the *pioneer* in modern methods of high-production trackless mining, builds compact, highly efficient machines for every mining condition. ● Let us help *you* to increase tonnage and reduce costs... WRITE FOR INFORMATION.



The JOY 14-BU Loader, for heavy-duty, high-production loading. Having an over-all height of only 30½ inches, the 14-BU operates efficiently in seams as low as 34 inches, with a capacity of 5 to 8 tons per minute.



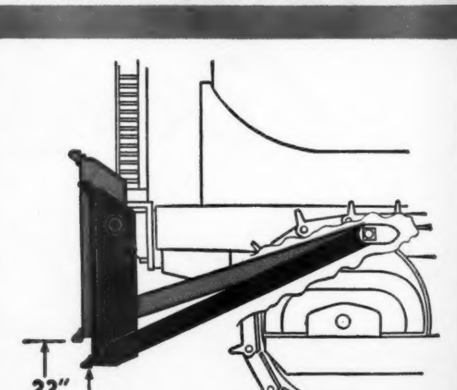
The JOY 42-D Shuttle Car, for fast, high-tonnage moving in medium seams. Available either battery-powered or by hydraulically-controlled cable reel, and with a hydraulic adjustable elevated discharge, if desired.

HD-19 TORQUE OUTPUSHES

On Any Stripping Job, Any Time

BIG VOLUME You get heaping loads fast with the BIG HD-19 pushing your scrapers on stripping work. A powerful, 40,000 lb. tractor with long, wide, sure-gripping tracks . . . it gets in there and really "bears down."

What's more — makes contact faster with any make or type scraper combination — no trundling along behind trying to catch up. Hangs on, too, throughout entire loading period — no losing scraper, no sudden, jarring contacts because there's no stopping to shift. Torque Converter automatically synchronizes HD-19's speed with speed of loading unit. And with a final, extra boost, gets scraper off with a flying start. Result — MORE YARDS MOVED AT LESS COST PER YARD.



NEW HEAVY-DUTY, ADJUSTABLE PUSHER PLATE NOW AVAILABLE FOR HD-19. It's bigger, stronger, heavier — weighs 1,600 lbs. It's adjustable — operates at 16" or 22" above ground . . . pushes any make scraper or self-powered hauling unit.

Surface Preparation

Methods and Equipment for Dewatering and Drying Washed Coal

By **Orville R. Lyons**, Research Engineer
Battelle Memorial Institute

THE dewatering and drying of coal is a subject that includes a multitude of methods and a variety of equipment designed to solve both general and specific problems. Although considerable information is available from the literature and from the manufacturers about the operating characteristics of the various types of equipment, it is surprising how difficult it is at times for a coal operator or preparation engineer to use the available information or data in solving some specific problem. The information presented in this paper is intended to provide methods for estimating the results to be expected from the use of certain types of dewatering and drying equipment and thus provide a basis for making a choice between the various types of equipment available. Through necessity this paper has been confined to a discussion of dewatering by means of screens, centrifuges, and filters, and thermal drying by means of a variety of equipment.

In any discussion of this nature, in order that misunderstandings may be eliminated insofar as possible, it is necessary to define the terms to be used.

The moisture content of any given increment of wet, washed coal is made up of two parts, inherent and surface moisture. Inherent moisture has been defined in various ways and no standard definition has been agreed upon. However, for the present purposes, it is considered as that moisture which is present in the coal in the bed. The important point to remember is that coal with any amount of inherent moisture, whether 2 or 20 percent, will appear dry if there is no surface moisture. Also important is the fact that inherent moisture can be removed in part even by air drying at atmospheric temperatures.

Surface moisture is that attached to the surface of the coal particles or that retained in cracks or fissures, other than capillary openings, in the coal substance. Essentially, insofar as the bituminous coal industry is concerned, dewatering and thermal drying are chiefly concerned with the removal of part or all of the surface-moisture content of the fine coal being treated.

For the purposes of this discussion, dewatering is defined as being the mechanical separation of a mixture of coal and water into two parts, one of which is relatively coal-free, the other relatively water-free with respect to the original mixture; while thermal drying is defined as being the evaporation of water by thermal means from a mixture of coal and water.

The paper then covers various dewatering methods and equipment, describing the use of shaking screens, vibrating screens, centrifuges and filters, and with each type of equipment there are tables and charts showing operating data and dewatering results with various sizes of coal.

In recent years, because of market demands, thermal coal dryers have been incorporated in more and more preparation plants to evaporate surface moisture not readily or economically removed by mechanical dewatering devices. In almost all cases the coal to be thermally dried is dewatered by mechanical means to provide a final surface moisture in the range of 5 to 10 percent prior to going to the dryer. The coarsest sizes are dewatered by shaking screens, the intermediate sizes are dewatered by shaking and vibrating screens in series, and the finest sizes of coal are dewatered by vibrating screens and centrifuges either separately or in series, or by thickeners and filters in series.

For the purposes of this paper, the discussion of thermal drying has been limited to two problems: (1) What type of dryer should be used to dry a particular coal, and (2) how much will it cost to thermally dry a particular coal?

Mr. Lyons tells how the solution to these questions may be approached, giving a table on "Thermal Dryer Operating Data," chart showing "Relation Between Size of Particle and Type of Dryer" and a curve plotting the "Relation Between Amount of Water Removed and Cost of Drying." He concludes as follows:

This paper has presented some empirical methods for determining the types of equipment to be used in solving specific moisture-reduction problems. It is hoped that the presentation of this information will impress the reader with the fact that much remains to be learned about methods and equipment commonly used for dewatering and drying coal and that the individual operator can aid all other operators by publishing any operating data that he possesses for any type of equipment. There are indications that laboratory or field investigations might materially increase the effectiveness of some methods for dewatering and drying coal, even though these methods have been used for years.

Heat Drying Raw Slack

By **J. C. Johnston**, Preparation Engineer
Eastern Gas & Fuel Associates

THERMAL drying of fine coal may be required because of high moisture in the raw feed or because of moisture added by wet cleaning. The dryer capacity and operating routines will not be identical for the two types of feed, since the feeds themselves are different. The total moisture in a raw feed is seldom as high as in one from a wet washing plant, but it is practically always more variable.

The drying unit discussed in this paper is used to remove the moisture, acquired in mining, from ⅜-in. by 0 slack as a preliminary to pneumatic cleaning. The coal comes from a bed having an inherent moisture of 1.0-1.2 percent, and reaches the dryer with a total moisture which varies generally between 3.5 and 7.0 percent, although a few extremes of 2.5 and 9.0 percent have been recorded. Experience has shown that coal in which the moisture varies as widely as this cannot be consistently cleaned by air. Even if there is no blinding of the deck cloth, it is impossible, when cleaning large tonnages, to readjust air pressure or volume to compensate for the changing reaction of the coal in the cleaner resulting from moisture variation. In this particular feed the coal and impurity separate in a uniform and predictable manner, as long as the total moisture content is under 4.0 percent. After the moisture passes that figure the air tables have to be reset each time the moisture varies by about 1 percent and efficient separation is difficult.

Setting maximum capacity high enough to reduce the exceptional 8 percent and over moisture to 4.0 percent was regarded as uneconomical, so the reduction chosen as maximum in this case was 3 percent. During periods in which this much reduction is unnecessary, the heat of the intake air can be reduced as the feed rate and amount of air are constant.

There are several types of thermal dryers on the market. The one in use at this plant is a Link-Belt multi-louvre, selected primarily to fit the size of coal to be dried. In this type of dryer, the coal, although in intimate contact with the furnace flue gas which is the drying agent, is moved through the dryer mechanically, not pneumatically. The coal is introduced into the dryer at the level of the bottom edge of the mouth of the intake air duct. It is carried up across this intake on a series of louvres or trays mounted at their ends on two standard roller chains. As the chain revolves around the head sprockets the coal falls off and cascades down over the up-coming loaded louvres and across the mouth of the intake duct.

Air for the dryer is heated in an Economy furnace. Originally the furnace was fired with a dust approximately 48 mesh by 0, and this fuel was picked up by the draft and burned largely in suspension. Later the top size of the coal was changed to ⅜ in. and although the bulk of the fire is now on the floor of the chamber, combustion is satisfactory. Ordinarily the air duct to the dryer acts as a stack, but a standby stack is provided for use when it is necessary to cut off intake air to the dryers. The furnace is rated to heat 57,800 cfm from 60 F to 850 F.

Both inlet and outlet ducts are equipped with Brown Instrument Co.'s heat control systems. These consist of thermostats, which are set manually for the temperature wanted, and after such setting they operate automatically to keep inlet temperature uniform and outlet temperature below the set maximum.

After a detailed description of the equipment, its operation and the results, the paper concludes:

The furnace and dryer have been in two-shift operation for 20 months. Dur-

ing this period there has been one minor repair to the stoker motor. The ignition arch at the front of the furnace now needs relining. The side walls have not been relined, but, since some parts will undoubtedly need to be replaced sooner than others, the cost of relining could be reduced if the sides were sectionalized instead of being built in one piece.

We have had one breakdown on the dryer caused by failure of a speed reducer. The air tumbler has been in operation a little over a year, and after it was installed there were some changes made in the water inlets, but other than this there has been no maintenance work done on it. The sides of the cylinder in this tumbler are, however, showing the effect of the constant scouring with small dust particles and water, and it is probable that when these side plates are replaced a special abrasive steel, or some type of coating, should be used. This type of wear is similar to that so frequently found in the bottom cones of cyclones, which in most cases have to be renewed every three to five years. The operation of the tumbler does require wasting an effluent mixture of water and coal solids. When scrubbing 15,000 cfm of air this was 24 gpm in which there was 6 percent of solids by weight. There are, no doubt, plants where this effluent would have to be clarified. This has, however, not been a problem with us as the mixture is wasted as it comes from the tumbler.

We have had no fires or damage to the dryers from heat except those directly due to carelessness. It has been previously noted that the outlet ducts of the dryers are equipped with heat control mechanisms, and that the thermostats are set to temper inlet air when outlet temperature exceeds 180 F. Due to some construction work in the plant these controls were damaged and, because of the lack of replacement material, not immediately repaired. Serious damage has resulted in the dryers twice, due to the feed of coal being interrupted for a considerable length of time during which the inlet air was neither tempered nor cut off. In both cases the louvres were so badly warped that a number of them had to be removed. In one case, in addition to the damage resulting to the louvres, the coal remaining on the louvres was ignited. Experience with these dryers indicates that the outlet temperature control equipment is vital, in that without it damage to, and fires in, the dryer will almost inevitably result.

Although the plant is largely automatic, it has been found necessary to have an operator in it. He has time to help out in the cleaning plant, which is in the same building, but it is necessary to limit his other duties so he will not be away from the drying section for long periods.

Effect of Added Moisture on Coal Screening

By **W. R. Caler**, Preparation Engineer
Enos Coal Mining Co.

THE Bureau of Mines Safety Department has continually stressed the importance of scientific and practical methods to suppress the dust common to the mining of coal. The methods and means advanced must at the same time consider the problem of screening, which is of utmost importance to obtain the uniformity of product demanded by sales managers and power plant engineers.

Mine managers have gone along with every idea for dust abatement to the extent that any suppressor used, should strike a happy medium—that is, relieve the dust condition underground and at the same time be practical to the point that mining and preparation of coal can be carried on to meet the most efficient standards possible with modern facilities. To put the clearest light on the fundamental principles involved, it will be necessary to show by operating observations how theory and facts have progressed.

Moisture, with its unlimited variations, has always presented an obstacle, both in deep mines and the strip mines, to the screening and classifying of coal. In allaying dust, water, asphalt emulsions, and soluble oils have all been tried with limited success, but to make this paper practical from a moisture standpoint, water will be discussed as the basic unit. Operating methods and weather conditions of surface mines offer a valuable comparison of moisture limits with those of deep mines that use haphazard spraying at the face during the operations of loading, cutting and drilling.

In spraying for the abatement of dust, apparently it is a matter of opinion as to the amount of water applied. Some mines require considerable more application than others, as the character of the seam and surrounding conditions all enter into the question. There has been considerable spraying done, but from various sources of information, little record is being kept as to the nature of conditions involved, and amounts of water used.

One mine, spraying for a cutting machine, is using approximately 80 gallons of water in making a 5-in. by 7-ft depth cut, in a 30-ft room. This calculates around 8.5 percent surface moisture added to cuttings. By the time the coal from this place is shot down, loaded, transferred, and conveyed to the tipple, the screens at 5/16 in. and 3/16 in. meshes are blinded but very little by the sprayed water, as contrasted to the blinding by coal that has actually been loaded wet in the mine. Therefore, in the tipple, it is easy to distinguish between coal coming from wet places and from dry places where the coal is sprayed to allay the dust. In some places the water is applied by pipe lines with hand spraying, others with sprays that produce a heavy mist. Apparently, there seems to be no water application method devised to assure the maximum of dust suppression and still let us know the extent that screening in the tipple will be affected.

For the actual coal screening, three general types are used—the bar, the reciprocator, and the vibrator. The inefficiency of the bar for true sizing has practically eliminated it from modern practices. The reciprocator type is generally accepted on the coarser sizes down to 1½ in. for the raw and ¾ in. for washed coals. The modern vibrator generally will do fairly well down to 5/16 in., but any lower than that they are limited according to their ability to condition the coal for screening. Of course the percentage of undersized allowed, will have to be gauged by market requirement.

In all cases, coal will screen only where the force of gravity can act on a piece or particle in such manner that it is free to move through the screen opening without interference. Put one piece on any screen and it passes through the opening readily. But, put a ribbon of material on a screen plate or cloth and the number of forces and their direction acting on the particle are numerous. Each one tends to hinder the free passage which is the basis for screening. The adhesion of unlike molecules and the cohesion of like molecules, the restricted area of bars or wires, the buoyant effect of the ribbon of material, all cause component forces which prevent the gravity action that is necessary to cause a particle to drop through the openings. In each of the above details the direction of the component forces change, resulting in the material being more difficult to separate.

It is my opinion that various kinds of reciprocators and vibrators can be used to accomplish the classification of coal. If you take a horizontal perforated plate of one inch or smaller and apply forces to it at right angles to the force of gravity, little screening takes place, regardless of how severe the forces are applied. However, if you take the same plate and apply forces at right angles to the plate and parallel with the force of gravity, you will have the maximum screening action that can take place and will at the same time keep the perforations open.

In the first case, the material slides back and forth over the openings and the buoyant effect of the material keep the undersized particles from going through the openings, but at a slow rate, which from a continuous material flow standpoint will be inefficient. In the second case, the material will be thrown into the air and at the same time be diffused to the extent that the momentum of the larger pieces will carry themselves higher than the smaller pieces. As they all return to the perforated plate the small pieces will be on the bottom of the ribbon and will be able to pass right on through the perforations.

The machine that is built and designed to approach this condition of screening will be the most efficient covering the widest moisture variations. All kinds of drives with every conceivable motion and action on the screen surface are on the market, a few of which approach the actual way necessary to give controlled uniformity of sizing over such wide scopes and are in demand by the coal industry.

Dense Media Separation Process

By **H. R. Randall**, President
Rhoads Contracting Co.

and

Edgar Schweitzer, Mechanical Engineer
Lehigh Valley Coal Co.

THE cleaning plant designed and erected by Link-Belt Co. has been in operation at Park No. 1 Colliery near Mahanoy City, Pa., since about January 1, 1949. The plant was designed for a capacity of 275 TPH of 4⅜-in. by 0 coal, of which all sizes about 3/16 in. are fed to the heavy media unit at the rate of 160 TPH. The sizes under 3/16 in. are not processed at this operation. They pass from the wet screens to a screw-type classifier for dewatering and removal of approximately 35 mesh by 0 material before passing direct to cars. Classifier overflow passes to a settling pond for drainage and water clarification.

H. R. Randall

Raw mine-run material is brought by truck and rail to the original breaker building, where it is screened at 4⅜ in. The undersize flows by gravity to the raw coal conveyer which feeds the new washery addition, and the oversize is hand-picked, crushed to minus 4⅜ in., and added to the natural raw 4⅜ in. by 0. The combined natural and crushed 4⅜ in. by 0 raw coal is then conveyed to the top of the new screening plant and discharged to a pair of double-deck vibrating screens, where an efficient wet separation is made at 3/16 in. on screens of the high speed vibrating type.

The resultant 4⅜ by 3/16-in. raw coal is then fed with the heavy medium into a float-sink concentrator where a float and sink separation is made at a specific gravity between 1.73 and 1.74. The clean float coal is flumed to a single-deck, high-speed vibrating screen on which the coal is rinsed free of all fines and magnetite particles and de-watered. The coal is then loaded by gravity into railroad cars and transported to a screening plant for classification into the various standard anthracite sizes.

Refuse produced in the specific gravity separation is also rinsed and de-watered on a separate, single-deck, vibrating screen and is discharged into a bin for disposal by truck or conveyor to the refuse bank. Minus 3/16-in. material from the raw coal vibrating screens passes with the spray water to a screw-type classifier.

After a detailed description, well illustrated with drawings and charts, showing the processes for the coal separation and for reclaiming the magnetite the paper concludes:

The average hourly rate of feed to the concentrator is about 230 tons per hour, which is approximately 45 percent more than the design capacity. We have found that this rate of feed provides a well balanced operation, although we have handled as much as 282 tons per hour without difficulty.

The specific gravity of the medium is recorded continuously and checked by means of a litre container and balance at frequent intervals. No difficulty is experienced in maintaining the gravity within plus or minus 0.01 of the desired separating gravity. In fact, there are many days during which the medium gravity remains constant throughout the entire shift.

Operating data of particular interest to the operator were condensed from regular reports over a typical six-day period, during which the concentrator feed varied from 208 to 254 tons per hour, with an average of 230. During the period the medium gravity was maintained slightly above 1.73 and in no instance was it allowed to exceed 1.74 or drop below 1.73.

Considering that the raw coal is received from several sources in constantly varying proportions, and also that the amount of near gravity material constitutes about one-third of the total, the small percentages of sink in the clean coal and float in the refuse are quite significant. The total misplaced material represents only 2.05 percent of the feed. This sharp separation is in no small measure due to the close limits within which the gravity of the medium may be controlled with virtually no effort on the part of the attendant.

The present market demands a clean coal whose ash content conforms to rather rigid requirements. After careful analysis, we find that a separation gravity of 1.73 gives us a product that meets these requirements within permissible tolerances throughout the entire range of sizes, and at the same time affords a maximum recovery. The percentage of ash in the refuse float is of special significance, as it indicates that the float in all sizes except the Rice contains virtually no material below 1.70 sp gr.

The performance of this plant has been eminently successful. In addition to its simplicity, the outstanding feature of the float-sink concentrator is its ability to produce uniformly satisfactory results when handling such a wide range of sizes. Actual tests have proved that equally efficient performance can be attained at gravities above and below that selected for our regular operation.

Maintenance of Preparation Plant Equipment

By **H. D. Bowker**, Asst. General Manager West Virginia Coal & Coke Co.

MAINTENANCE of preparation plant equipment should be a major consideration in the designing of preparation plants. Without consideration for proper maintenance, the problems and cost are increased out of all proportion to the amount of tonnage to be handled. Simplicity in design is always helpful. Consolidation of control and other operating facilities, to keep the man-power required to operate a plant at a minimum, is important from the standpoint of operating cost. I mention this because in addition to the economic purpose, maintenance is less apt to suffer. It is never economical to let a major maintenance job go because the over-all operating cost is high. The lowest competitive bid for the construction of a preparation plant is not always the cheapest unless detailed specifications are adhered to. When determining the proper price to pay for any installation, the additional cost for material, proven to furnish longer life, must be weighed with the labor required for more frequent replacements, together with possible expensive plant delays resulting from breakdowns.

Increased maintenance cost can be expected for units that are not easily accessible for inspections and repairs. Failure of such units cause additional delay time, which can be expensive in cases of key units in high capacity plant. Efficiency from the mechanics is gained by having proper lighting so they can see to perform their work.

Sufficient capacity must be figured for all units to prevent overloads. Underestimating the capacity for units, such as conveyors, makes it necessary, after a plant is constructed, to speed them up, which adds to the maintenance cost. There is always a tendency in preparation plants, as well as other industrial plants, to try to increase the capacity for which it was designed by utilizing the last ounce of safety factor, which was designed into it. In our new plant, all conveyors were set up to run 75 fpm. Should it become necessary to utilize this safety factor, they could be speeded up to 100 fpm without adding too much to the maintenance cost of any particular unit. To date, this has not been necessary. Overloading conveyors with fine coal or wet coal can prevent proper lubrication, resulting in excess wear on conveyor chains. Overloading any unit generally shortens its life and adds to the maintenance cost. For units such as screens and cleaning units, overloading affects their efficiency therefore ample capacity should be incorporated in the original plans for the entire plant.

Working preparation plants two shifts a day, six days a week, adds to the maintenance problems. Frequently, large jobs occur requiring more time than is available on the third or off shift. Maintenance work done on Sunday is expensive as it generally requires paying labor double time. Planning ahead and planning in detail helps in many instances to reduce, in part, the additional expense involved. This includes starting maintenance jobs before they become large enough to require extra time. Two plants in one are rarely found except in cases where two different coals are processed separately. In some instances, however, it is feasible to make plants flexible to the extent that the plant can continue to operate in case some units fail. By employing two duplicate small units in place of one large unit, it could be arranged so that the plant might still operate at a reduced capacity in case one of the units would fail.

Regardless of what precautions are taken to prevent mechanical failures, they will occur and as mentioned before, the resulting delays can be extremely expensive, especially in high capacity plants. Storage capacity for the run-of-mine feed either in the form of a run-of-mine feed hopper, or in mine cars, or both, serve well at times to prevent loss of production in the mines supplying the plant, in the event of a plant failure. This also permits certain maintenance work to be done on an operating shift at less expense than when done on overtime or double time. Surge hoppers or storage hoppers for the run-of-mine coal serve advantageously in supplying a uniform feed to preparation plants. Storage hoppers at the dumps are necessary in the event that drop-bottom mine cars are used. For mines with small tonnage output, storage hoppers can make it possible for the preparation plant to operate a single shift rather than a double shirt, thereby, cutting the operating cost as well as the maintenance cost on the plant.

Preventive maintenance should be continually in the minds of the men in charge of preparation plants. Too much emphasis cannot be placed on the importance of preventive maintenance or what it can do in the way of keeping maintenance cost, loss of tonnage caused by break-downs, etc., at a minimum. Constant attention to all equipment is necessary. Regular and systematic inspection is the key-note to any well planned maintenance program. Inspections of the equipment must be made by men qualified in making inspections of mechanical

equipment and who are capable of employing good judgment. At our Dorrance Colliery central cleaning plant, we employ a man referred to as an equipment inspector, whose sole job is to make regular and continuous inspections of all equipment. No job in the plant is considered as being of greater importance. The equipment inspector works directly under the superintendent and assistant superintendent of the plant and works with them in lining up the maintenance work to be done by the master mechanic and his force on the third or off shift, as well as for certain jobs that would have to be done by the mechanics on the regular operating shifts.

Proper lubrication is one way of preventing maintenance. We have found the Farval one shot lubrication system to be satisfactory for supplying grease to the different units. The amount of grease to each unit is proportioned according to its requirements. Our records prove that with this system, less labor is involved and that a marked saving is made due to using the proper amount of grease. Automatic oilers, designed and built in our own shop and installed to automatically lubricate conveyor chains, etc., resulted in similar savings.

Complete maintenance records are essential to keep the management properly posted at all times on the trend of maintenance cost, delays caused by poor maintenance, and unit costs. In order to keep power maintenance records and arrive at individual unit costs, it was necessary to number each unit in the plant. Any labor or repair parts used for maintenance or repairs to the units are charged accordingly.

In conclusion, it is highly important that the men responsible for the operation of a preparation plant, realize their responsibility and follow a few simple rules:

(1) Make regular and systematic inspections
(2) Plan maintenance work well in advance
(3) Execute this work in a workmanlike manner
(4) Keep adequate records of work done and materials used
(5) Order promptly and keep on hand essential parts

If these rules are observed, the preparation plant superintendent can guarantee the production department maximum operating time at a reasonable cost.

In the absence of Mr. Bowker, his paper was presented at the Convention by T. R. Workman, vice-president, West Virginia Coal and Coke Corp.

Ventilation

Ventilation of Kaiser Sunnyside Mine

By **R. G. Heers**, Manager
Kaiser Co., Inc.

AN analysis of the ventilation of a mine affords the opportunity to evaluate the advantages and disadvantages of the particular system employed. The following description of the system of ventilation used at the Sunnyside mine of Kaiser Co., Inc., may benefit the planner who is charged with the job of designing a system of ventilation for a mine with similar conditions. It has been demonstrated that for mining properties that are adapted to this system, pressure ventilation combined with bleeder entries and one-way coursing of the air pays big dividends in delivering a plentiful supply of fresh air at the working faces and reducing the hazard of accumulations of bad air or gas. These objectives can be accomplished at relatively low cost.

The present system of ventilating this mine evolved from a step by step process. When the mine was reopened in 1942 after having been closed for 18 years, the block of coal which was to be mined was partly surrounded by old workings. An upper seam in part of the area had been mined out. The atmosphere in the old workings had largely been depleted of oxygen.

When the fan was first installed it was used as an exhaust fan drawing the return air out of the mine. An important weakness in this system was soon discovered. There was a tendency in all sections that were adjacent and open to old workings to pull bad air out of the old workings into the active places. This was especially noticeable during periods of low barometric pressure. Many attempts with seals and stoppings were made to prevent the approach of the bad air to the working places, but these met with only limited success. The bad air remained too close for comfort. A cave to the upper seam, an accidental breakthrough to the old workings, a broken stopping, or a falling barometer would bring bad air into the working places.

To solve this problem, the simple idea was conceived of reversing the fan. At first this merely entailed reversing the rotation of the fan rotor and coursing the intake air to the normal intake airways and haulageways. This was done with satisfactory results. Later, at an opportune time, the fan was turned around on its foundations so that it operated in the direction for which it was designed. To keep the intake air from going out the main haulageway to the surface, an air lock consisting of two automatic doors was allowed to ventilate the main haulageway. All other haulageways were also kept on intake air. A return to the surface was obtained by utilizing an opening in the old workings at the south end of the property. The old workings were kept free of bad air by coursing the return air through them.

Some of the first workings in the mine were on the south side and consisted of two large barrier pillars. When the pressure system and the return air outlet to the south end of the property were installed, one of the important advantages gained was that of one-way ventilation. After pairs of entries had been completed in each of the barrier pillars, instead of continuing the conventional loop system of ventilation, both the haulageway and return air course were put on intake air. After ventilating the working places, the return air went into the gob and then to the surface. So well did this system work in mining the old barrier pillars, that it was decided to extend its use to future developments on the north side of the mine.

By this time it became clear that the following objectives of good ventilation could be obtained by pressure ventilation, one-way coursing of the air and the use of bleeder entries. They were: (1) delivery of an adequate quantity of fresh air to each working section, (2) elimination of accumulations of bad air or gas in all worked-out areas, (3) elimination of the hazard of drawing bad air from old workings into active workings, (4) reduction to a minimum of the amount of regulation required, (5) cutting to a minimum the number of permanent stoppings and overcasts, (6) low mine resistance and consequent low power cost, (7) operation of haulageways on intake air only, (8) reduction of dust being carried in air courses.

Regulation has proven to be exceedingly simple. It is accomplished by simple brattice curtains at the mouth of each section. The mine is self-regulating to a large extent. The open splits, i.e., the ones with highest resistance, are those along the middle of the cave line. This is because the return air from these entries has the longest distance to travel through the gob. Regulation is also made easier by having a surplus of air in circulation.

The absence of dust flowing out in the return air courses which in ordinary ventilation systems parallel the haulageways is an advantage which one-way ventilation gives. This characteristic has been especially noticeable at this property. The return air deposits its dust in the gob where its hazard is at a minimum. The use of rock dust is consequently reduced and safety conditions are improved.

In conclusion, it should be stated that this system of ventilation has been used, studied and compared with others on a point by point basis and it has been found that in practically every respect it has more to offer in the way of safety and economy than most of the more commonly used systems in use in similar properties.

Auxiliary Ventilation at Geneva Coal Mine

By **R. J. Bowen**, Mining Engineer
Geneva Steel Co.

THE Geneva coal mine is located at Horse Canyon, in Emery County, Utah, nine miles south of Dragerton in the Sunnyside area. Coking coal, for the Geneva Steel Plant, U. S. Steel subsidiary, is mined from the lower Sunnyside seam of the Book Cliffs field. The seam in general averages 14 ft in thickness at the Horse Canyon property. It pitches 12.5 percent eastward under rough mountainous terrain from the outcrop high on the escarpment of the Book Cliffs.

Room and pillar mining is completely mechanized. Two distinct types of mining machinery units are in use, namely: the shaker conveyor units and the mobile loader units. A shaker unit consists of the conveyor with duckbill, a shortwall cutter, a post mounted drill, and a hand held electric drill. Mobile loader units are of two types, i.e., the track mounted unit consisting of a high-capacity loader and a universal cutter with mounted drill; and the trackless unit consisting of a crawler-type loader, a rubber-tired cutter, a mobile drill, two six-ton shuttle cars and two elevating conveyors.

The mine is ventilated by two 84-in. Jeffrey Aerodyne fans exhausting a total of 335,000 cfm from the main return airways. The north fan is located in Horse Canyon proper near the north portal and exhausts 137,000 cfm at 2.68-in. water gauge pressure while the south fan located above the rock tunnel exhausts 198,000 cfm at 1.04-in. water gauge. Each fan is V-belt driven at 670 rpm by a

2300-v, 75-hp, 1200 rmp, synchronous motor.

Air enters the mine through six portals. Four of these portals represent the main entrances in Horse Canyon, the other two being the rock tunnel extending from the top of the main slope, and the Lila Canyon escapeway about one mile and a half south of Horse Canyon. Air is conducted to and from the mining districts through the main entry system, aided by boundary return airways. Intakes and returns are separated by plastered cinder block stoppings and concrete over-casts. Proper proportioning or splitting is accomplished by slide-door type regulators. The mine is classed as nongassy.

After the air arrives in the working district, the important problem is to make effective and efficient use of it in compliance with Federal and State regulations for nongassy mines. This is accomplished by proper use of auxiliary blowers, check curtains, and line brattice.

Blowers used in entry development and advance mobile mining are of the permissible d-c Jeffrey Midget Aerodyne type, driven by a 1½-hp series motor. Its small size and portability permits it to be readily installed by setting on a bench or shelf at the side of the entry. Each blower is placed 40 ft from the near rib of the last open crosscut and 15 ft in front of the check curtain. This arrangement precludes the possibility of recirculation as long as a plentiful supply of air is maintained. The quantity of this supply varies from 10,000 to 25,000 cfm per mobile loader district.

Care and proper supervision are the watchwords for installing each blower. Source of power is the 250-v trolley. The lead wire is clamped securely to the trolley and extends to a 30-amp fused switchbox mounted on a timber placed for this purpose. Leads from the switchbox go to the permissible blower which is fused at 20 amp. Separate ground wires are attached to the frames of the blower and switchbox. The district mechanic does the wiring and takes care of any maintenance required to keep the blower operating continuously throughout the shift.

The paper, after discussing a typical installation, continues:

The main disadvantage of the blower is noise. This is not only irritating but makes it difficult to hear a trip of cars approaching the check curtain. This hazard was reduced by installing sirens on the gathering locomotives. Mechanical failures, although not great in number, are always to be reckoned with since the blowers have to be operated continuously. It is therefore necessary to have on hand emergency spare blowers. Out of 36 blowers at Horse Canyon 23 were sent to the shop for repairs last year. On this basis, a relatively new blower operates on average of about 18 months before major repairs are required. The mine operates two shifts per day.

Among the main advantages of the blower is lower cost in both labor and material. Brattice is soon worn beyond usefulness after being reinstalled a few times, while vent tube lasts much longer. Vent tube requires little room and is therefore less restricting to operations than line brattice. Especially is this true in heavily timbered sections; when additional timbering is required, it is rather difficult to do the work and at the same time maintain line brattice, while the tubing offers little hinderance. In the vicinity of faults, which are quite numerous, exceptionally bad roof conditions are encountered resulting in caves that require cribbing above the crossbars. In such places a line brattice is difficult to install and maintain.

Management

Management-Employe Responsibility for Mine Safety

By **Charles W. Connor,** Manager, Mining Division, Armco Steel Corp.

THE success of any mine safety program must necessarily depend upon the willing cooperation of management and men. Neither of these groups alone can accomplish the desired end. Each one has a definite function in the program, and, working together, they can develop an understanding that will be lasting and productive of best results. Only through such cooperation can safer methods of working and the prevention of accidents be attained.

Management has been defined as the adhesive tape which binds capital and labor together. It is from this group that must come the inspiration, the financial backing, the moral support, and the guidance and direction in originating and developing a comprehensive safety program. And only with the support of top management will such a program endure and succeed.

The employe group, on the other hand, must provide the power to keep the ball rolling, once it has been started, by accepting and obeying the various rules and regulations set up to make the plan workable and by observing and putting into use the standard practices adopted for governing particular jobs. Mine safety remains largely an individual matter, and the ultimate attainment of perfect mine safety rests primarily in the individual mine worker. After all, he has the most at stake in the venture, for it is his life, limbs, and health that are involved.

Granting that this is true and assuming that the employer is conscientious in his endeavor to eliminate accidents, then if the cooperation of the individual can be enlisted, the problem can be solved and the goal can be reached. It would appear, therefore, that the most important question to be considered is: "How can that cooperation best be secured?"

Since certain responsibilities must be assumed by each group, the prime requisite for cooperative effort must lie in the creation of mutual confidence. The individual worker must be convinced of the sincerity of purpose of the employer, that is, he must feel that the employer really means business. The average mine worker is one of the hardest persons in the world to fool, and this is especially true about his personal safety. He cannot for long be "soft-soaped" by a barrage of speeches, posters, pay envelope stuffers, flag-flying, trite sayings and catchy slogans. These are useful adjuncts, as far as he is concerned, only when accompanied by visible activity on the part of the employer for the betterment of working conditions and the correction of hazards.

A further responsibility which management must assume is to furnish the worker with a clear understanding of all the reasons for the various rules, regulations, and practices adopted for operating the program. Worker resistance is frequently built up against certain new procedures because no one has taken the time or trouble to thoroughly explain to the worker what they are intended to accomplish and why they are necessary. This is information to which he is entitled and may be imparted to him through several media—group meetings, safety meetings, radio talks, right-and-wrong pictures, moving pictures, and through personal talks by mine officials and the plant safety engineer.

After a thorough discussion of the duties of the safety engineer, stressing the importance of his part in the safety program, Mr. Connor then emphasized the need of training for employers and supervisors. He further spoke of the need for cooperation between men and employer in the enforcement of rules as follows:

Little has been said about union participation in the safety program, and there is little that can be said about it. From the national standpoint it has been conspicuous by its absence. The international union has directed its efforts almost wholly toward safety by legislation, but safety never has and never will be made effective by laws and rules alone.

If the headquarters organization would throw its support behind the local effort and encourage the miner to share in the task of learning how to protect himself, instead of rendering lip service only, tremendous improvement in the accident record would be shown. That this can be done is shown by the favorable results achieved in District 29 in southern West Virginia where a safety engineer employed by the union has conducted an accident prevention campaign, with the cooperation of the employes and employers, over a period of three years with commendable improvement in accident frequency. If the leadership of the local union can be induced to back the safety program, that assuredly is most desirable as the willing cooperation of management with the mine safety committee can be especially helpful in securing local union support.

However, the individual remains the key to confidence and cooperation. If he can see that hazards are eliminated, that machinery is guarded, that equipment is well maintained, that good housekeeping is practiced, that recommendations of Federal and State inspectors are being complied with, it is a sure bet that he will respond and do his part of the job. If he is kept informed as to progress of the plan and its results through statistics, news letters, house organs, bulletin boards, safety meetings, etc., there is little danger of his enthusiasm lapsing, and management can be assured of a safety program that will function on a truly willing basis.

Attracting Young Men to the Coal Industry

By **Henry C. Woods**, Chairman of the Board Sahara Coal Company

IN attracting young men to the coal industry, there's a real job cut out for us. As you all most likely know, the year 1949 shows the biggest enrollment in colleges and universities of any year in our history. Free education offered the ex-soldier under the G.I. Bill of Rights is, of course, largely responsible for this. This is fine; but not many, in fact, very few, choose coal mining engineering as their course of study. Why? A recent survey as late as August 1948, by Dean Steidle of the Pennsylvania State School of Mineral Industries, reports that enrollment of students in coal mining engineering courses has fallen off this year, whereas, the enrollment in petroleum, metallurgy and other engineering courses has increased.

How do you attract men? You do not attract them unless you see them or let them see you. They probably do not seek you or your jobs so you have to go to them. After looking into this problem for the last few years I have definitely come to the conclusion that we have to seek these prospective students or workers at the high school level. Here is where the coal operators' problem starts as well as that of the university offering courses in coal mining engineering. After we have provided the proper elementary and high school course of studies in our mining communities or cities we must become acquainted with those who are running them and sell them on our industry and its future possibilities. High school principals and educators need just as much selling or more, to induce workers or students into our industry. They can kill a sale or stifle enthusiasm before we even start to work.

Back-breaking hard work for the miners is gone. Thousands of dollars have been spent on safety, so that today we have a place to work that will compare with any industry of comparable size, or magnitude. These things did not just happen, but they did come quickly. Who is going to be responsible to see that all this new expensive machinery, this electrical and mechanical equipment, is going to be kept repaired and operating? It requires a *new kind of trained technician* and qualified mechanics to keep it going and protect our capital investment, and see that sufficient additional volume of coal pours over the machines to justify their purchase. The old coal miner is woefully inadequate and that is where vocational training at the high school level comes in. Who wants to put an inexperienced coal miner on a $50,000 continuous miner? Who wants an inexperienced supervisor or foreman not educated in mining, mechanical and electrical courses at the college level to keep these machines in continuous production? The answer is up to us. What are we going to do about it?

Believe me, the teachers and principals of high schools need education about coal mining and its future possibilities. The war is over and unemployment is creeping up. The young person preparing for his life's work wants to know where to go—or where to turn for his future security. We coal operators in Illinois have worked out a new plan at the University of Illinois in conjunction with Dr. Harold L. Walker, head of the department of mining and metallurgical engineering and his associates at the university to remedy this situation and to—(1) arouse interest and (2) show the educators themselves that great possibilities exist in our industry. We operators have agreed to underwrite a week's course each year at the university in "Careers in Mining Engineering." The operators will pay all expenses for 25 or 30 high school principals and/or vocational guidance teachers from the high schools (and possibly junior colleges), for a five-day program. Each year we intend to invite different educators.

We are also working on another program with the extension division of the university. This university and others which do not realize what coal and their mineral resources mean to their own State had better wake up to their problems or should I say their possibilities. The extension division of the University of Illinois hopes to open up this program this fall or shortly thereafter. They expect to offer a variety of lecture courses in the extension program. The lecturers will be hired and supervised by the university and lectures will be given either two or three nights a week in the local mining communities—probably using the local high schools as a meeting place.

As an additional suggestion to other coal operators and their associations, we have formed in Illinois a committee made up of the head of the department of mining and metallurgical engineering and three professors of mining engineering at the University of Illinois, along with seven coal mining executives and one representative of the fluorspar industry. The purpose of this committee is, of course, cooperation—one to advise the other.

After the student has entered the university whether on a scholarship or not, our job has only begun. At regular intervals, once or twice a year, some one assigned by your company or my company should visit the university and the students and see how they are getting along. A pat on the back or word of encouragement always helps and you can become better acquainted with some of your future employes. You can determine who will make a good man for you and probably help plan his courses along particular lines that your company is interested in. You also can advise the university of changes and methods, markets, etc., about your industry which will keep the universities on their toes and up-to-date in all respects.

One of the other most important things is to offer summer employment to those students taking mining engineering and encourage them to accept employment if they desire it. This will give these men additional valuable education in their life's work.

Strip Mining

Recent Developments in Overburden Drilling

By **Howard S. Frisbie**, Assistant Superintendent Broken Aro Coal Co.

OVERBURDEN in the strip mining operation usually falls into the following classifications: (1) earth, loose rock, or gravel; (2) shale or soapstone; (3) limestone; (4) hard sandstone. In the first classification usually no shooting or drilling is necessary, and no discussion is necessary here. In the second classification, shale or soapstone, drilling has never been a serious problem.

It has been found in our operations that an auger drill has given the most satisfactory results. All operators are familiar with this type drilling; the subject has been well covered, and no real problem is to be faced in this class of overburden. In regard to drilling, emphasis might be placed on the uniformity of the spacing, depth, and height above the coal since skilled shovel and dragline engineers will use this to their advantage in the operation of their machines. The decision as to whether the holes should be vertical or horizontal depends upon the results required. We have found in our operations that horizontal is the cheapest and most convenient, but vertical will give the best results, especially when the overburden is removed with draglines.

In the third and fourth classifications, that is, limestone and sandrock, a satisfactory solution to the drilling problem is yet to be found. Most methods are either too expensive, too slow, or inadequate. Observation was made of the methods of drilling limestone in Illinois and Kentucky. Churn drills, rotary drills, and jackhammers were studied. Reports of different drilling superintendents show they are looking for more positive and convenient methods.

At the Homestead Coal Co. mine near Earlington, Ky., two seams of coal are being stripped—No. 12, and No. 11. Over No. 12, which is the top seam, lies hard sandrock. Between No. 12 and No. 11 is 6 ft of solid limestone. One of the most difficult problems of drilling exists in this operation.

Limestone Drilling

The problem of drilling the 6 ft of limestone will be considered first. Numerous methods were tried out, and as a result, two wagon-type jackhammer drilling machines were constructed in the shop at the mine. They have been in operation since April of 1948. A set of

29T Bucyrus-Erie crawlers were obtained along with the propelling machinery, and upon this was mounted a Sullivan 14½-in.-8¾-in. by 7-in., 800-cfm air compressor. On the front end of the crawlers, three Sullivan drill jibs were mounted 4 ft apart. These jibs are 8 ft long, and by swinging them to the side, three rows of holes at a maximum distance of 12 ft apart, or at any lessor spacing may be drilled. A Sullivan TM 350 drill assembly is mounted on the end of each jib, and bore a 2⅜-in. hole using 9-ft steel. The extra length steel is used so that it may be upset and used again when it breaks at the head or shank. The crew consists of three men, a man to each jackhammer, who also load the holes as the machine drills.

The drills are run side by side, and the hole spacing is about 6 ft. A canopy of 3/16-in. steel plate is built over the drills to protect the machinery against weather and falling rock. The rock is shot once every 24 hours, which requires the drills to be moved out of range of falling rock once a day. They are powered by electricity and have the following advantages: (1) they are mobile and compact. (2) The jackhammers may be operated at any angle or spacing without delay. (3) They are close to the ground and servicing is simple. (4) Production or footage is sufficient to keep ahead of the stripping.

Provision is made to attach an airhose and jackhammer for any secondary shooting that may be necessary.

Special Drill Built for Sandstone

The problem of drilling the sandstone over the No. 12 seam ahead of a 1050-B shovel and keeping out of the way of the shovel is one of the most difficult. In some places there is a little seam of blue shale just above the coal, and drilling was done both horizontally and vertically, the back side being drilled vertically. The results have not been too good, and as the overburden increases, some method has to be worked out to drill the sandstone from the top. The engineers of the Sinclair Coal Co. and the Bucyrus-Erie Co. set out to design a vertical drill with the following objectives in mind: (1) The drill must be self contained in a compact unit. (2) The drill must have maximum mobility and travel over rough or muddy terrain. (3) It must be of minimum height over-all so that it will pass under powerlines or other obstructions. (4) The revolutions of the drilling head must be variable rather than constant. (5) The raising and lowering of the drilling head must be so controlled that it may be fast or slow with the pressure variable.

A size 42T Bucyrus-Erie set of crawlers and propelling machinery has been obtained upon which will be mounted all machinery. On the drilling end will be mounted two hydraulic jacks with a single jack on the other end for the purpose of keeping the drill level. These crawlers are about 11 ft long and have a pad that is 3 ft in length. The over-all length of this drill will be about 18 ft and the width about 13 ft with the height about 13 ft.

Instead of a mast or tower, a horizontal boom is constructed and a d-c gearmotor is installed at the end. The opposite end of the boom is fastened to a hinged gantry or leg. In the approximate center of the boom, a hinged arm is connected to a stiff gantry located on the drilling end of the unit. At the point in the boom center, a hydraulic piston is fastened vertically to raise or lower the boom. As the boom is raised or lowered, the arc formed by the point of the boom is offset by an opposing arc formed at the center of the boom and the point where the drilling motor is attached travels in nearly a vertical straight line. This principle allows a minimum height.

Strip Mine Blasting with Liquid Oxygen

By **Don B. McCloud**, President
Airmite-Midwest, Inc.

WHEN men began to mine coal by stripping off the overburden above the coal seam, they found that existing equipment was inadequate. So the industry proceeded to develop new machinery and new methods of procedure to solve the unique problems encountered in this new method of getting out coal. The first full revolving shovel was built for a coal stripper. Each subsequent generation of shovels has surpassed its predecessors. Haulage equipment, preparation plants and most of the other equipment found at a modern strip mine has been developed step by step by this constantly growing industry.

Strip mine operators discovered long ago that overburden containing rock or shale has to be well shot before a shovel can move it efficiently. Overburden blasting involved new problems not encountered in any other type of mining, so the coal strippers proceeded to develop new equipment, a new explosive and new blasting procedures to meet these problems. The fact that overburden blasting is the largest single operating cost item at many mines, provided the incentive for strip coal operators to spend time and money in working out new ways of promoting efficiency in this important phase of the stripping operation.

Overburden blasting consists of drilling and shooting. Twenty-five years ago, the only available drills for this work were rope-line churn drills mounted on wheels. The coal strippers, with the cooperation of drill manufacturers, began making improvements in these drills until now we find modern churn drills equipped with hydraulic leveling jacks, that put down a 10-in. diam blast hole in less time than it took the old fashioned drills to sink a 6-in. hole.

The first self-propelled horizontal drill was built for a coal stripper. Since then the industry has developed huge horizontal-type machines that drill two rows of holes, one 20 ft above the other. By means of such drills, overburden up to 75 ft in depth is handled at a tremendous saving over the cost of drilling by other methods.

The same sort of progress has been made in explosives. It is axiomatic that a powerful, high explosive is necessary to shatter and displace hard overburden. About 20 years ago, in an effort to find a better blasting medium than the existing fixed explosives, the coal stripping industry seized upon liquid oxygen explosive which was developed in characteristic fashion to meet their needs.

Description of Airmite

Airmite is a simple mixture of extremely pure carbon and liquid oxygen. It is made by saturating cartridges with liquid oxygen at preparation plants located within easy trucking distance from the blasting areas. A cartridge is a cloth bag lined with a sheet of sturdy corrugated material and packed with a unique type of extremely pure lampblack that is manufactured under rigid specifications especially for this purpose. Cartridges are made in diameters ranging from 3½-9 in. to correspond with the various sized blast holes used.

After describing the manufacture of the cartridges and the blasting procedure, Mr. McCloud concludes:

Excellent Safety Record

There has been widespread misunderstanding about one feature of liquid oxygen explosives and that is the hazards attached to their use. As stated before, innumerable varieties of liquid oxygen explosives can be produced, and during the past 20 years Airmite has not been involved in a fatal accident. By this it should not be inferred that it can be handled with impunity because there is no such thing as a "safe explosive." Anything that will blow up under any circumstances is bound to be more or less dangerous and no high explosive can possibly be foolproof. However, the fact that millions of pounds have been handled under practically all sorts of field conditions for the past 20 years, without a fatality, indicate that no unusual hazards accompany its preparation and use.

A number of things besides luck have contributed to this enviable safety record. The most important factor has been an understanding on the part of everyone concerned that the safety characteristics or the sensitivity of liquid oxygen explosives depends entirely upon the nature of the cartridge. As in the case of many high explosives, every ingredient of Airmite is covered by rigid specifications, and a comprehensive safety code covering each step in the preparation, transportation and handling of Airmite, is in effect on each job. Cartridges are manufactured, saturated, transported and handled in the field in accordance with well-defined, simple rules of safety which involves the honest cooperation of everybody concerned, on and off the jobs. So far this safety program has paid off.

The fact that liquid oxygen evaporates at ordinary temperatures limits its effective life but in compensation for this, the explosive has a unique safety feature. In case of a misfire as, for instance, when one hole of a group shot fails to go off with the rest due to a defective cap or broken wire, there is absolutely no danger of the stripping shovel digging into any explosive. In such a case, after the explosive has remained in the ground for a few hours, all the liquid oxygen will have evaporated from the cartridges leaving in the misfired hole only bags of carbon which are completely non-explosive. Many shovel runners like this.

The field for Airmite is quite limited. The installation of a preparation plant is not justified unless it turns out about 100,000 lb of explosives per month, so its use is restricted to large consumers of explosive. Field conditions and the blasting setup also affect its use. Comparatively speaking, it shows up best in extremely hard rock where its high rate of detonation produces unusual shattering effect and the high volume of gases evolved upon detonation produce exceptional displacement. So far, it is being used almost exclusively at large coal stripping operations where the overburden conditions make blasting a costly but vital matter. It was developed entirely within the coal-stripping industry and has contributed to the advancement and progress of this industry by making possible the efficient blasting of heavy overburden which before the advent of modern shovels and Airmite blasting was considered too tough to strip.

In the absence of Mr. McCloud, this paper was presented at the Convention by Dean E. Albon, chief engineer, Airmite-Midwest, Inc.

Use of Fixed Explosives in Bituminous Strip Mines

By **A. B. Austin**, Assistant District Manager
Hercules Powder Co.

RAPID progress has been made in coal stripping technique during the last 15 years. Larger and more efficient equipment, and improved explosives, some designed especially for such work, have made this progress possible. The ratio between depth of overburden, that can be profitably stripped, and the thickness of the coal seam is steadily increasing. This is due chiefly to the larger equipment having greater overburden disposal range and there is no reason to believe the limit has been reached.

Modern excavating and hauling equipment is so spectacular that everyone is aware of it. It took engineering genius to create it, and its contribution to the advances in stripping technique is generally recognized. Perhaps there is less general knowledge of the continuous research conducted by the explosive industry; of the improvements in fixed explosives which have resulted; and the extent to which these improvements have been helpful to the progress of coal stripping.

Fixed explosives, as the name implies, have their various characteristics definitely established by formula. They are constantly checked and verified in the laboratory and remain the same for long periods of time if the explosives are properly handled and stored. As a result, they are most convenient and economical to transport, store, handle, and load. These explosives give such uniform results that it is possible for the explosive engineer in the field to reduce uncertainties to a minimum. When the characteristics of your explosives are both fixed and known, there is less tendency to overload, thus wasting explosives and increasing costs. The economy is obvious.

Improvements for Efficiency and Economy

We have referred to improvements in fixed explosives, that have special value for coal stripping. The research that has been devoted to perfecting the high-count ammonium nitrate explosives has been especially valuable to strip miners. In general, these bulky powders have replaced the denser gelatin and nitroglycerin grades at a great saving in cost per unit explosive energy. Although nothing that will explode can rightly be called "safe," these explosives which are most widely used in stripping have been made less sensitive to heat, friction, and impact; and they are among the safest explosives known.

Also, the ammonium nitrate explosives, the most economical ever developed, have been improved in water resistance. Not only that, but they are packed in cartridges of heavy, spiral-wrapped paraffined paper with crimps fluted and sealed with a pouring of wax. These cartridges are made as large as 50 lb in weight, packed one to a case. A later innovation is the 23G package which is a 50-lb cartridge so strong and rigid that it needs no shipping case other than its own sturdy shell. Such cartridges provide added protection to the powder so that it will withstand a considerable amount of water if the cartridges are not slit or otherwise opened. The improvements that have been applied to these explosives makes them even more suitable for coal stripping.

Another marked advantage of fixed explosives is that numerous grades provide a wide variety of strengths, rates of detonation, cartridge sizes, water resistance, and other qualities. Because many different conditions are encountered in coal stripping, it would be difficult for one explosive to meet them all efficiently. Each stripping operation where blasting is necessary is a separate and individual problem, requiring study and analysis. Our technical representatives when making such a job study and analysis must therefore carefully consider the following:

(1) What are the physical characteristics of the bank to be blasted? How high is it, and what is the material?

(2) What drilling equipment is available?

(3) What digging equipment will be used?

(4) How can the best displacement and fragmentation be secured?

After discussing these questions Mr. Austin concluded:

Fixed explosives are the only ones that have their characteristics built permanently into them so that with proper care and handling, they give uniform performance. This enables the consumer to use the kind of explosive and estimate the amount needed to accomplish the desired result—thus obtaining the greatest efficiency and economy in blasting.

By their very nature, fixed explosives are convenient and economical to transport, store, handle, and load. Because of the wide variety of grades, which provide a full range of strengths, sizes, rates of detonation, densities, water resistance, and other characteristics, fixed explosives will meet all of the many and varied conditions encountered in strip mining. The ingenuity with which fixed explosives have been packaged, and the variety of packages available, add to the convenience and economy of their use in open-pit operations. The grades used most widely for stripping are among the safest explosives known.

We are fully aware that in the final analysis, the removal of overburden from the coal is of prime importance. However, this overburden must be properly prepared by blasting, if blasting is necessary, for the digging equipment to remove it from the coal. In order to obtain good preparation, the correct amount of explosive energy must be properly distributed in the overburden. This can be accomplished by placing the correct grade and type of fixed explosive in the holes drilled in the correct pattern for the specific bank.

During the next 15 years there will no doubt be other changes in equipment and stripping technique which will further advance the industry. Our research with the end of improving fixed explosives will continue and as stripping methods advance improved explosives will be ready to aid in the progress.

Deep Stripping with the Tower Excavator

By **Harold N. Hicks**, Engineer
and
Howard Truax, General Superintendent
Truax-Traer Coal Co.

IN the modern methods of strip mining, it is generally recognized that where possible, a single stripping unit, either a shovel working from the coal surface or a dragline working from the surface or on a bench, is the most economical and high production machine known. Also, a single stripping unit in a pit is the simplest method, requiring a minimum of engineering and planning.

When overburden becomes too deep to be handled economically by a single unit, either dragline or shovel, or if the material to be stripped is unstable either in the high wall or the spoil pile or both, it then becomes necessary to add an auxiliary unit of some type to help out and work with the primary stripping tool.

There are, as you know, various combinations of machines which have been tried in the stripping industry. Some of these auxiliary units have a dual purpose in most installations. They not only must dig but they must also transport material away from the mining cut. Furthermore, this haul must be a sufficient distance to give additional spoil room or to spread out the spoil material over a large enough area to prevent the unstable material from causing slides. If the high wall is unstable and has a tendency to slide, then the auxiliary machine must be able to lower the height of the high wall to such a point that it becomes stable and transport this material back on the spoil piles far enough to cause stability.

Many different combinations of shovels and draglines and even tractor drawn scraper equipment have been tried for this purpose but to our knowledge the tower excavator, consisting of a head tower, tail tower and employing a scraper type of crescent bucket, had not been tried.

Development of Tower

The tower excavator was first designed and built in about 1915 by the Bucyrus-Erie Co.; they continued to manufacture

Harold N. Hicks

this same machine with minor modifications until about 1930, and later—about 1936—two special tower excavators were built by them. During this 21-year period, 30 machines were built and shipped. Twenty-three of these were for contractors working on levee building projects along the Mississippi River and its tributaries, five tower excavators were for a Canadian power project. The two built in 1936 went to work for the Oliver Mining Co. on the Mesabi Iron Range in Minnesota, and were used for cleaning up and finishing the mining operations in an iron ore pit where a considerable amount of iron ore would have been lost in the track benches.

The tower excavator can be considered a primary digging tool in that it has the ability to uncover the coal vein without auxiliary help and also to box cut. However, we have used it as a supplemental or auxiliary machine to assist stripping shovels in handling high overburden that was beyond the range and capacity of the shovel working by itself, and also to reduce the high wall to a stable condition. We are now operating two of these units. The first one was put into operation in North Dakota in 1943, used in tandem as an auxiliary machine to a Bucyrus-Erie ten-cycle stripping shovel.

After describing the operating method, Mr. Hicks summarizes as follows:

In North Dakota, where we experience severe cold weather, we have found that the tower cannot successfully dig frozen dirt. Out there the frost penetrates to a greater depth than in Illinois and we therefore plan our tower work so that we can accomplish the year's work in seven or eight months and then tie up the machine when the frost gets to a non-workable depth until the frost comes out in the spring.

Although the output of a tower excavator in yards per hour is low, the slope which it leaves on the spoil pile cannot be disregarded when digging in unstable material because of the comparatively gentle slope which the tower leaves, and also it has been found that the dragging of the scraper bucket over the spoil does a good job of compaction.

It is my belief that it is unfair to compare a machine designed between 20-30 years ago with a modern shovel or dragline incorporating the great advances which have been made in their design in the last ten years. I believe that the manufacturers of this type of equipment could build a new tower excavator today incorporating the improvements which have been made, particularly in the electrical equipment, that would materially increase the output of tower excavators to a point where the balance between the output of the tower and a larger shovel than the 10 cu yd would result.

Deep Stripping Methods with Large Shovels

By **Andrew Hyslop, Jr.,** Chief Engineer

and

Russell McHugh, Chief Engineer, in Charge Stripping
Hanna Coal Co.

THE term "large shovels" is one whose application changes with the times and what we now term "large shovels" sometime in the future be not so classified. However, it is reasonable to assume or predict that shovels which have a dipper capacity of from 33-50 cu yds and booms and dipper handles with sufficient length to permit the removal of an overburden depth of 70-80 ft will remain in the "large shovel" classification for quite a few years henceforth. In contrast thereto, shovels with a dipper capacity up to 8 cu yd and booms and dipper handles to permit the removal of overburden up to 50 ft are classified in this paper as "small shovels" for the purpose of comparison.

Economic reasons are varied but in connection with coal stripping are generally composed of the following: (1) decreased stripping costs, and (2) greater recovery of resources per acre.

It is possible, when stripping for Pittsburgh No. 8 coal in Eastern Ohio, by which method about 7000 tons can be mined and recovered per acre, to strip the overburden in an area lying between the 9-ft cover and the 50-ft cover with the use of a 45-cu yd capacity shovel at about 45 percent of the cost of doing the same work with an 8-cu yd capacity shovel, drilling and blasting and power costs included in this comparison.

Also, a 45-cu yd shovel with sufficient length boom and dipper handle to strip to an 80-ft highwall, can strip an area lying between the 9-ft cover line and the 80-ft cover line at about 77 percent of the cost of an 8-cu yd shovel stripping between the 9-ft and 50-ft covers, with drilling and blasting and power included in the comparison.

The area lying between the 50-ft cover

Andrew Hyslop, Jr.

and the 80-ft cover, when stripped by a 45-cu yd capacity shovel will cost about 25 percent more than the area lying between the 9-ft cover and 50-ft cover when stripped by an 8-cu yd capacity shovel.

In the foregoing comparisons, the average monthly yardage of the 8-cu yd capacity shovel is 189,665 cu yd and the average monthly yardage of the 45-cu yd capacity shovel is 1,000,000 cu yd from 9-50-ft cover, 961,640 cu yd from 9-80-ft cover and 942,000 cu yd from the 50-80-ft cover.

Drilling and blasting has been included in the foregoing comparisons due to the fact that the preparation of materials to be stripped and removed plays such an important role in the efficiency of the shovels in handling the overburden. The overburden must be adequately prepared if the shovels are to have a high percent of operating time and handle a great amount of overburden. Inadequate overburden preparation results in decreased operating time and high maintenance cost.

Increased Recovery

With respect to a greater recovery of resources when stripping for Pittsburgh No. 8 coal in Eastern Ohio, normally the recovery per acre through stripping methods will result in a 55 percent increase over underground mining methods or 7000 tons per acre by the stripping method as compared with 4500 tons per acre using underground mining methods.

Theoretically, in a uniform strip area wherein no hollows or inside curves exist, there can be recovered by the stripping method, using a 45-cu yd shovel, about 73 percent more coal when stripping to an 80-ft highwall than by the use of equipment capable of only stripping to a 50-ft highwall. However, in a strip area indented with numerous hollows or inside curves, this increase may be reduced to about 31 percent.

This results in an increase of 18 percent recovery of natural coal resources when using a 45-cu yd capacity shovel stripping to an 80-ft highwall in a uniform sloping strip area wherein no hollows or inside curves exist as compared with small shovels stripping to a 50-ft highwall and then mining the coal between the 50-ft highwall and the 80-ft highwall by underground mining methods and an increase of 9 percent recovery when using a 45-cu yd capacity shovel stripping to an 80-ft highwall in a strip area indented with numerous hollows or inside curves, as compared with small shovels stripping to a 50-ft highwall and then mining the coal between the 50-ft highwall and the 80-ft highwall by underground mining methods.

Used in the above was a recovery of 7000 tons per acre by stripping methods and 4500 tons per acre recovery by underground mining methods with a coal seam height of about 4 ft 9 in.

Capital Cost Considerations

It is admitted that the economics of "large shovel" operation will probably appeal more to a corporation or operating company which owns a large block or area whereon there is coal to be recovered by both stripping and underground mining methods, than a corporation or operating company owning only coal to be mined by the stripping method. But that does not alter the fact that in almost all cases, if not all, the mining of coal by stripping methods results in a greater recovery per acre than mining by underground methods. Also, if the coal lying between the 50-ft cover and the 80-ft cover can be mined at reduced costs by the stripping method as compared with the underground mining method or methods, there is further incentive to consider the application of "large shovels" and examine the economics involved in order to arrive at a decision on whether or not it is profitable to make the necessary capital expenditure required.

Now comes the question of when are "large shovels" the economical equipment to use in stripping. The stripping cost savings per unit of resources when compared with the use of small shovels may seem quite great, but the area to be stripped must contain a sufficient quantity of coal so that when the savings per unit of resources is applied to the total amount of resources the total savings more than overcomes the additional capital expenditures required.

The amount of additional stripping cost savings over necessary capital expenditures will depend to a great extent on corporation policy, including sales prospects or demand for the coal being produced and the anticipated selling price of the product.

Mr. Hyslop's paper continues with further figures and discussions on design improvements in large shovels, development factors, tooth and lip design.

Deep Bituminous Stripping Methods with Large Draglines

By **Arthur E. Dick, Jr.,** President

and

Donald B. Dick
Dick Construction Co.

FOR somewhat more than half a century our company and associated organizations have been engaged in coal stripping operations in both anthracife and bituminous areas. For a good part of this time, and especially during recent years, we have been concerned with the application of draglines of various sizes and types to the solution of certain of our stripping problems. We wish to emphasize that in presenting a paper of this nature it is not our desire to be placed in the position of recommending the dragline as a stripping tool of universal application. Where the dragline has been ultimately selected by us as the proper machine for use in par-

ticular stripping work, the decision to do so has been reached always after thorough consideration of the natural conditions surrounding the project and the various economic factors which might be expected to exert an influence upon its successful prosecution. In a number of instances the decision has been reached to employ shovels rather than draglines and it should be apparent that proper machinery selection should be predicated upon unbiased and impartial weighing of all the influences which might be expected to enter into the purchase and use of the machines finally chosen.

Our experience in bituminous coal stripping has been largely confined to Virginia, West Virginia, eastern Kentucky, and western Pennsylvania. In these areas, because of the essentially horizontal nature of the coal seams and the relatively steep topographic slopes, the thickness of overburden increases rapidly as successive cuts are taken following approximately the contours of the ridges. The stripping conditions change, therefore, with considerable rapidity from those of shallow overburden to those of deep overburden, and even though the over-all ratio may be favorable the problems are basically those of being properly equipped to handle deep overburden.

Advantages and Disadvantages of Draglines

In overcoming the difficulties attendant upon this type of work, the large walking dragline because of its long dumping range is able to spoil deeper overburden and so work further into the hillside than is the roughly corresponding size stripping shovel. This simply means that the stripping life of the property is increased roughly in proportion to the greater dumping range of the dragline.

In following the topographic contours in areas of this type, it is apparent that the stripping operation is frequently confronted with the necessity of working rather sharp re-entrant angles or inside curves in heavy overburden. Where such conditions exist the maneuverability of the large walking dragline as compared to the large stripping shovel is of the greatest value in working out these difficult situations.

It has been our experience that the large walking dragline is operable at an appreciably lower maintenance cost per cubic yard than a large stripping shovel of roughly equivalent size. In our opinion this is due in large part to the extreme flexibility and the inherent elasticity of the drag and hoist cables which form the digging element of the dragline. Destructive shock loads are not transmitted to the main machinery and structural frame work of the excavator to nearly the same extent as is the case in large stripping shovels.

Until recent years it was our conviction that in comparing anticipated outputs of shovels and draglines of the same dipper and bucket capacities, the shovel could be expected to produce approximately 30 percent more yardage than the dragline. We find that this is no longer true when considering the modern dragline such as the Model 1150-B in which the use of the twin ropes has imparted to the bucket a stability and positiveness in digging far from approached in draglines employing single cables. Another factor of major importance in increasing the productive capacity of the walking dragline has been the providing of hoist line speeds ranging from 390-620 fpm with dragline speeds in proportion, which, coupled with suitable digging effort, has decidedly minimized the former disparity in performance between shovels and draglines.

Another factor which may tend to favor the employment of a walking dragline rather than a stripping shovel is one which is not inherent in the natural conditions surrounding the stripping project, but one which has developed among manufacturers of stripping equipment. This is that the walking dragline is available in an almost complete range of sizes from 4-30 cu yd whereas in attempting to use stripping shovels we find that there is no size available between the 6½-cu yd Model 170-B and the 21-cu yd Model 550-B machines. This is a condition which it is hoped will be overcome some time in the future for reasons which will be mentioned later, but it is a factor in machine selection which is of not inconsiderable importance at present.

A major disadvantage in the employment of a large walking dragline for hillside stripping is the necessity of providing the machine with a suitable base or roadway from which to operate. In rocky overburden this becomes especially difficult because of the relative inefficiency of such a machine in digging above its base in this type of material, and it frequently becomes necessary to use a close-coupled shovel solely for the purpose of preparing this roadway with a consequent disadvantageous effect upon costs. Where vertical drilling methods are used, this type of preliminary preparation is somewhat reduced in importance because it is required that a suitable surface be provided from which the vertical drilling machines can operate, as well as the walking dragline. However, where the stripping shovel is employed, this surface for the vertical drilling machines can be much less elaborate than if it is to be used also for the positioning and maneuvering of a large walking dragline. The preparation of this working foundation for the machines is a necessity, and its cost should of course be given due consideration when endeavoring to evaluate the suitability of either the stripping shovel or the large walking dragline to a particular job.

Mr. Dick then describes methods of bank preparation, discusses combining shovels and draglines and concludes his paper with comments on the general position of strip mining in the coal industry, ending with the statement that: "It can be confidently expected that the strip mining of coal will continue to be an important factor in our national economy with the proper exercise of intelligence and foresight by those concerned in this vital effort."

Current Practices in Anthracite Stripping

By **C. E. Brown**, Mining Engineer
The Philadelphia and Reading Coal and Iron Co.

MR. BROWN'S paper was published in full in the April MINING CONGRESS JOURNAL.

Contour Mapping by Aerial Photography

By **George L. Hess**, Photogrammetric Engineer
Aero Service Corp.

AERIAL mapping interests the strip mining engineers today for the same reasons it claims consideration in other industries—its economy and its accuracy. Although precision aerial mapping has been used by many industries for years, its application to your industry is relatively new. But it has proved its worth in practical use now by a number of stripping companies who find it meets all the specifications of plane table mapping. Moreover, modern aerial mapping brings four major advantages over ground methods. These are: (1) cheaper; (2) faster; (3) more accurate and detailed, and (4) explores at minimum cost, narrowing the contour mapping to areas of particular interest.

Aerial mapping delivers three main products to stripping companies: stereo pairs of photographs for geologic study—mosaics for quick reconnaissance purposes—and topographic maps for detailed development planning. Here's how these services are used by your industry. The pairs of aerial photos are studied under the stereoscope by stripping companies' geologists and engineers, to observe the area's relief in a third dimensional perspective. Not only is this a major timesaver over detailed ground studies, but—more importantly—geologic features which may be overlooked by ground parties are often seen through stereoscopic study. For example, brush may obscure or make difficult the tracing of outcrop by field parties, whereas in areas which have not been glaciated, the benching can be traced in well-defined relief under the stereoscope. Certainly field checking remains necessary, but with aerial photos it is directed toward the study of critical areas and worthwhile anomalies.

These photographs are assembled in precise aerial mosaics, the *second* product of aerial mapping used by your industry. These mosaics also save time and cut ground exploration costs; though not as accurate as a topographic map, of course, they reveal a wealth of cultural detail in true relative scale. In reasonably level terrain the mosaic is a good map for any use except where contours are required. Most companies use it to explore an area quickly, thereby narrowing the focus for contour mapping to the sections where the development will be planned. Ground methods do not permit such reconnaissance; plane table parties cannot collect for you the preliminary information you need to say, "these sections only are the ones for which we'll need contour maps." With plane table or stadia methods, the entire area must be mapped.

In compilation of contour maps, elevations must be obtained with field survey crews for these control points, in order to draw the contours accurately. Nine vertical control points are obtained for each pair; horizontal controls consist of several points established along each flight strip.

Finally, the most exact product of aerial surveying is the topographic map. After the area of interest has been selected from stereo study of the photo pairs, and from study of the controlled mosaic, then the contour mapping compi-

lation for this narrowed area begins. In constructing these maps from the photography, a minimum amount of ground control is required, and the base control is run with theodolites, carrying vertical and horizontal measurements simultaneously. The horizontal closures average better than 1 in 20,000; vertical control must close 0.05 ft per mile run. Most of these shots exceed 3000 ft and since visual signals are not practical over such distances, compact radio transceivers are used to speed communication between instrument men and rodmen.

These topographic maps serve as an excellent base for the plotting of such data as property owners' names, drill holes, legends, outcrop, and other details. Maps made by the aerial method may range in scale from 1 in. equals 100 ft to 1 in. equals 1000 ft. The contour interval may be 2, 5, 25 ft, or greater, as required. Standard aerial mapping specifications demand that 90 percent of the map be accurate within one-half contour interval, and that no part of the map be in error by more than one contour interval.

Three brief comparisons will help appraise the values of aerial mapping in your business. First, consider the big saving in time possible—aerial photography requires days; ground methods take weeks and months. When ground control is obtained for aerial mapping, it is not necessary to cut through brush or difficult terrain, for a minimum amount of control is needed. Points are not required as frequently as in stadia or plane table mapping. Furthermore, contour drawing on the precision stereometers is much faster than plane tabling or interpolating field notes. Add this up, and the time schedule for mapping by aerial methods is one-half or less than that for ground methods.

How does detail in the aerial method compare with maps produced by ground methods? The aerial topographic map is the more detailed product. All details, such as ponds, buildings, fence lines, and power lines are secured. No minor terrain change is overlooked, and better expression is found in the contour lines of an aerial topo map. Thirdly, the mapping plane is independent of terrain; it maps swiftly over flat or rugged country, free of terrain problems which slow the ground surveyor.

In summary, then, aerial mapping will deliver aerial photos for stereo study—controlled mosaics for further reconnaissance—detailed contour maps for the narrowed areas of interest. It delivers them faster and cheaper than ground methods. It has been tried and proved by your industry, and by a host of others, in many areas.

Open-Pit Power Distribution

By **John J. Huey,** Electrical Engineer
The United Electric Coal Cos.

THE strip mining industry operated for many years during the late part of the nineteenth century and the early part of the twentieth century with steam-powered equipment. Steam power was thought to be ideal for the equipment in use at that time since it could be applied smoothly with high starting torque and good rates of acceleration. However, with the gradual development of larger machines, the problems of handling fuel and water as well as the labor involved to service the boilers and water lines, the interest in electric power became great enough to cause the development of an electric stripping machine in about 1915. This, of course, required use of some method of power distribution to provide the necessary energy to drive these machines.

These distribution systems in the early days were arranged with the common 2300-v, three-phase delta, but as machines became larger and the need for grounding the system became apparent, the trend was to the 4160-v, three-phase, Wye-connected system. This is basically the arrangement which is used at most strip mines today. The latter system now is generally complete with a neutral grounding resistor which is used for protection of personnel.

Until recently most of these distribution systems have been constructed along more or less conventional practices as used by the public utilities. Open line construction consisting of 25-ft poles, standard crossarms, insulators and other necessary items were used to construct the facilities to serve the strip mine equipment. This construction has given an extremely good account of itself and is still in use at most strip-mine operations. It has the advantage of being simple, rugged and reasonably free from interruption of service but has the disadvantage of being costly to set up and move with the present material and labor costs. It also requires frequent shortening of laterals, and considerable lightning protection, and for the modern type of large stripping unit is not adequate at present voltages due to high voltage regulation caused by the line reactance. These points will be discussed later.

The need for greater flexibility, rising material, and labor costs, and to some extent increased power delivery requirements, have caused the trend from open line to all cable and combination open line and cable distribution. As a natural outgrowth of the old open-line construction we first used cable laterals or feeders which eliminated the need of frequently cutting back the laterals. Previously, it was necessary to cut back these laterals at a rate of one or not more than two spans at a time which resulted in a considerable waste of copper conductor as well as of the labor required to make the frequent cutoffs. Consequently, at some long-established strip mines it is common to find the power conductors held together with a large number of splices. This splicing can, of course, be done with some of the more modern connectors but since these are rather costly, has been done largely by serving together the ends of the short pieces. This is most undesirable since it frequently causes hot spots and poor voltage delivery and occasionally results in burning down a power line.

In building the main line as an open overhead unit, care is taken to see that the line is as straight as possible, that the main conductors are as long as can be pulled conveniently up to approximately one-half mile for 4/0 copper. This, of course, requires careful and ample anchoring facilities at each end of the line. We have also found that in using large copper sizes the problem is considerably simplified by shortening spans from the usual 150-175 ft down to about 125 ft.

There are also a few other considerations I should like to point out in this connection: first, the use of stranded conductor is preferable for any sizes larger than No. 2; second, for mechanical reasons I would recommend the use of a ground wire equal in size to the phase conductors except for the larger sizes such as 1/0, 2/0 and 4/0 which should be stranded, and with the latter, I would suggest the use of at least a 1/0 stranded ground wire. Also, the ground wire should be of first-class wire since continuity is of vital importance. Third, I would recommend that the ground wire be placed on the cross arm between two of the phases. In the event that the ground wire is carried at one end of the cross arm, it is necessary to transpose the phases frequently. Fourth, the ground wire should be grounded to the earth at about every third pole simply as a safety precaution. This indicates the desirability of placing the ground wire at one of the inner locations on the cross arm since it thus facilitates connection to a ground lead running down the pole. One means of obtaining these pole grounds is to coil up several feet of wire and place it beneath the butt of the pole as the line is being set up.

I should like to add that the reason for transposition of the phases as mentioned above is that with the ground wire at one end of the cross arm, it is coupled more closely to the nearest phase wire and it is quite possible to obtain varying voltages up to 25 v on the ground wire and the frames of the machines relative to the ground. This voltage is proportional to the current flowing in the line and is sometimes sufficient to make the machine feel "hot."

The paper then covers the principal factors in open-pit power lines, including cable jackets, sub-stations, importance of continuous return, metering, maintenance, and the effect of low voltage, concluding with the statement that:

"Our goal is to provide a distribution system which is electrically efficient and selective as well as physically or mechanically rugged and dependable—and a system which provides a maximum of portability and flexibility."

Open-Pit Power Distribution

By **David Stoetzel,** Application Engineer
Mining Division, General Electric Co.

MR. HUEY has given us an excellent presentation covering the practical aspects of this subject from the operating engineer's point of view. I will endeavor to present the picture from an application engineering viewpoint—going into some additional consideration of conditions and reviewing the design and characteristics of the equipment and the devices available for putting together a complete and adequate power distribution system.

We may understand the problem better if we take a look at the load and the conditions on the high voltage utility line which is the usual source of power for an open pit mine. For the typical case we may assume that the power comes in at 33 kv, or something of that nature, and is stepped down to 2400 v or 4160 v for

David Stoetzel

local distribution. For large operations 4160 is usually used since it presents economies in transmitting large blocks of power and the Wye connection of the transformer secondaries, which is natural in this case, facilitates safety grounding. Although present open-pit power distribution voltages in this country are generally limited to 4160 v, consideration is being given to distribution at the 6900-v level in order to reduce size of trailing cables and reduce line voltage losses.

In some cases the substation may be the utility company's responsibility with metering on the low side of the transformers. In the majority of cases, the substation is part of the mining company's distribution system with metering on the high side of the transformers. There may be conditions which make it desirable that some part of the 33 kv (or similar) distribution will be the mining company's property rather than having the metering right at the high side of the substation.

A large electric stripping shovel requires a substantial and dependable power supply to assure continuity of operation. High momentary peak loads must be handled by high-torque, motor-generator sets driving motors. Since the induction motor torque varies with the square of applied voltage and synchronous motor torque directly with applied voltage, it is important that the terminal voltage be maintained as close to rated value as possible. Voltage dips of 5 percent will not cause trouble, but dips of 10 percent may seriously affect continuity of operation.

The nature of the load imposed on the power system by one of these large machines is not particularly encouraging to the central station people, although what it lacks in quality (for them) it makes up in quantity. It will be observed that high momentary peaks, up to approximately 200 percent of the normal rating of the equipment, occur frequently—approximately once during each cycle of operation. The peak power demands are almost invariably succeeded by valleys of regeneration. Some large shovels are equipped with counterweighted hoist machinery which will assist materially in reducing the momentary peaks.

Where a number of similar shovels are operating on the same system there will be an appreciable averaging in regard to the 15-minute demand, or, looking at it from the standpoint of equipment, in the transformer capacity required. The curve shows what we may expect in this direction. The presence of a number of similar machines on the same power supply system will also have a beneficial effect on peak conditions in that most of the peaks will cancel out to some extent with the low power and regeneration parts of the cycle on other machines. However, we must recognize that occasionally the peaks on most of the machines will synchronize. The greater the number of machines involved, the less frequently this will occur.

A word about power factor will help to complete the picture of the power demand. Larger shovels and draglines—about 9 cu yd and upwards—use synchronous motors for driving the motor-generator sets. Consequently the power factor of the load on these machines is practically unity on the peaks with considerable leading reactive kva being furnished on the lighter loads (average power factor approximately 90 percent leading). Smaller excavators use squirrel cage induction motors for driving the motor-generator sets. We may figure an average power factor of 80 percent lagging and a power factor of 85-90 percent lagging on the peaks. Some of the larger machines, with synchronous motors, are equipped with power factor regulating devices to promote holding power factor more nearly unity throughout the range of loads.

Although we are principally concerned with the load in the pit, it should be remembered that there is usually a related load consisting of the preparation plant and its auxiliaries. The characteristics of a typical load of this kind might involve 2500 hp total connected load, peak load—2000 kw, average load—1750 kw, power factor—90-95 percent (with static capacitators). These figures apply for a plant designed for approximately 800 TPH.

Mr. Stoetzel, after discussing other requirements for power application and a typical distribution system, outlines recommended practices, safety features, lightning protection, and concludes with the following look into the future.

Future trends in regard to the practices in open-pit power distribution will be determined largely by the continuing and increasing importance of, and demand for, good voltage conditions, flexibility of the distribution system, protection for personnel and order and similarity in the layout and operation of the various working units. Although much progress has been made in the past few years, studies are in progress with a view to further improvements in portability, easy disconnection and reconnection of cables and units and completely interlocked, automatic operation of the system as far as possible. Some of the problems are similar to those which exist in underground mining but are more difficult of solution on account of the higher voltages and larger amounts of power involved. Operating experience and the close cooperation of mine operators and manufacturers of equipment will lead to satisfactory solution of these problems.

Progress in Stripped Land Regeneration Research

By **A. G. Chapman**, Chief
Central States Forest Experiment Station

RECLAMATION research by the U. S. Forest Service on lands stripped for coal was planned to determine the most efficient ways and means of making these lands productive through forestation. The aim is to accomplish the job through obtaining the ecological facts of bank conditions in relation to tree growth. Reclamation cannot be realized through legislation without a factual basis, nor on theory alone. Furthermore, general reclamation principles must be flexible and sufficiently supplemented to meet essentially new and different situations. Getting the facts and applying them without bias is the philosophy of our personnel engaged in this work. It is a source of satisfaction to us to see the results of research at work in helping to make stripped lands useful.

To place the surface-mined lands to their best use should be an established policy in the mining industry. But before such use can be made of them, the way must be pointed by competent research and demonstration of its results. Recommendations must be practical so that interested landowners may make efficient and effective reclamation possible. Use of banks is first based upon their capabilities, that is, what profitable uses can be made of them. All of these are known in a general way and some of them in considerable detail; but more investigations are needed to determine further details and to clarify them. Second, those uses which best suit the needs of the landowner should be selected. The selection should be based on materials needed by the landowner, on net returns, and on the best interests of the community. The Central States Forest Experiment Station is now engaged in determining the place of forest production on stripped lands.

I have been asked to report on the progress of our studies and experimental plans for the future in the states of the north central region which we cover. The total acreage actually stripped, in the nine-state survey, was about 190,000 acres on the dates of completion of the survey by states. The proportionate distribution among states is not strictly correct since the dates of estimate ranged from October 1945 to June 1947. The combined strippings in the region compare closely with the area of an average county. This does not, however, include adjacent unstripped lands which may be affected. Since an estimate of the extent of the affected unmined lands during the survey would have been a matter of personal opinion, none was made. The extent and concentration of stripped acreage are represented on the regional map. (The extent and concentration of stripping in each county is shown by different colors.)

According to our standards of estimate, approximately 95 percent of the strippings can be reclaimed through establishment of some kind of forest cover. High toxic acidity is the chief factor which renders the remaining 5 percent unplantable. In general, spoils with a pH of four or less are too toxic for most plants. Degrees of acidity, within the range of plantable spoils, and other factors are especially important in the selection of species to plant on the reclaimable land. Acidity classes within the range of plant tolerance are set up as an important tool in species selection. In addition texture of the bank materials; general topography including degree of slope; aspect of slope, that is north, south, east or west; stability of banks as related to erodibility, slipping and settling; and character and density of natural vegetation found on banks at planting time often have their important influences.

What values may be expected from

forest planting on lands affected by stripping? First, planting will get the reclamation of stripped lands under way and result in timber stands which will help to meet the increasing needs of wood for industry, wood sources which will go far to guarantee the security of industry. And, second, it will ease the tension between the mining industry and proponents of legislation to control stripping. A good job will establish the sincerity of purpose. The question is often asked, "How much can we afford to invest in planting and management of the resulting timber stands?" Certainly no more than necessary, but no one is able to accurately predict the amount at present nor the economics of wood products 25 or 50 years hence. Prices of lumber have more than tripled in the past decade. It is perhaps safe to predict, because of increasing wood consumption and continued markets, that they will be higher in the next 25 years. Values in better public relations, although intangible in part, cannot be overlooked. Industry is in a good position to strengthen the vital forest resource.

We have not overlooked other uses for stripped land in our region-wide studies. They comprise the growing of forage crops for feeding of livestock, fruits and vegetables, and cover for wildlife; the use of impounded good water for fishing grounds, and the development of recreational facilities. Many examples could be cited of these uses which have been examined on the ground. Few of the banks will lend themselves to extensive cultivation. One chief use is usually made of an area, most often forest or forage production, or horticultural crops to provide the primary income after mining; but no land area can be fully employed unless all gainful uses, which do not interfere one with another, are made and properly integrated at one time. This is multiple land use.

We feel research and observations have progressed sufficiently to justify establishing perhaps two or three pilot plant areas in the region, a few thousand acres in each, to determine and demonstrate multiple land use on broad land-use concept basis. This kind of study has been requested of us and we are giving it serious thought for a future undertaking. The Forest Service is authorized to conduct forest and range research, and to cooperate with the Fish and Wildlife Service in research and administration. Should we initiate such a project, state and other Federal agencies will be invited to participate in the fields of work outside our authorization. The staff should be comprised of technically trained men in forestry, grazing, wildlife, fish culture, recreation, horticulture, etc. Income could be from sale of wood products, livestock grazed on range lands, fruits, and permits for hunting, fishing, and recreation. Such pilot plants in land use might well set a pattern applicable not only to stripped lands but to other vast areas now producing far below their potential capacities.

Steep Pitch Mining

In the Southern Anthracite Region of Pennsylvania

By **D. E. Ingersoll**, Division Superintendent
The Philadelphia & Reading Coal & Iron Co.

THE Pennsylvania Anthracite producing area is approximately 500 square miles in area, about one-half that of the State of Rhode Island, and is divided into three fields, namely, northern, middle (eastern and western) and southern.

The northern field, of which Pittston, Pa., is about the center, lies in a flat basin approximately 60 miles long 6 miles wide and contains about 16 workable veins, varying from a few feet to 20 ft in thickness. *The middle field* contains about the same number of veins in several basins, with veins varying in placement from horizontal through light to heavy pitch. *The southern field* contains many basins with steeply pitching veins, some of which extend to a distance of 3000 ft below the surface, or approximately 2000 ft. below sea level. Descriptions in this presentation refer to practices in that field.

These practices vary considerably as the wide range of conditions encountered render deviations that are desirable and necessary; for example, a vein 16 ft in thickness was being mined and pillars removed by skipping. This method offered too much exposure to the workmen and procedure was changed to splitting pillars with a narrow chute or pillar hole, from which headings were driven for ventilation at the required interval of 60 ft.

On retreat, intermediate slant headings were driven from which each remaining stump could be drilled and blasted. In each successive step, batteries were erected to retain the coal so that it might be drawn under control at all times; and also to protect the workmen and the lower portion of the breast still to be mined. Battery construction in this character of work is dependent upon thickness of vein, single or double prop batteries being used in thin veins, and double prop and bridge set construction being used in the thicker veins.

In another instance, a similar vein approximately 30 ft in thickness was being mined which discharged methane freely, offering a problem in ventilation, as well as control of face, as the gas pressure made it difficult to keep the places open long enough to be driven their planned distance. Both the ventilation problem and that of pressure have been solved by driving an opening 12-14 ft wide against the top rock, much the same as in mining contiguous veins, mining then being prosecuted in the lower part of the vein in the conventional manner.

In still another instance where the vein, approximately 11 ft thick, was exceptionally free and inclined to run, it was found practically impossible to advance the breasts more than 50 or 60 ft on a lift of 300 ft to the gangway on next level above. Slant chutes were driven right and left, above the heading, from which drilling could be done and blasting in these slants, plus angle holes at the face, started the entire lift which was drawn through a rock hole from the underlying vein. No control of recovery is possible under this method, but accounting of mine cars loaded from such mining has indicated a rather complete recovery.

The foregoing being of a general nature, it may be enlightening to describe in more detail a method which has found general use over a number of years with acceptable success as to safety, recovery and cost.

The veins are 4-15 ft in thickness and stand on a pitch of 70 to 80 deg. Chutes are driven 10 ft in width and 30 ft in length on 60-ft centers. Manways, 6 ft in width are driven in every other block to afford access to adjacent working places. Breasts are started 10 ft in width and attain their full width of 30 ft in 30 ft of advance. A box, constructed of mine boards known as the gob, is installed in the middle of the breast, beginning at the breast battery, leaving a traveling or manway 3 ft wide along each rib.

The material mined at the face fills the gob which is usually drawn down sufficiently low to accommodate the product of each cut. Excess material is run down the manway and joins the regular flow of coal at the monkey heading. The gob timber consists of 7-in. timber spaced on 3-ft centers to which sufficient 6-ft mine boards are nailed to complete the box. Steps 6 ft in length are nailed to the gob timber and extend about 2½ ft into the gob.

In veins 6 ft or less in thickness, prop timbers are used to form the gob, although in thicker measures "jugular" timbering method is used. A "jugular" consists of a prop set obliquely against the rib forming a triangular manway, of which the bottom rock and rib are the base and altitude respectively. In thick veins the top coal over the gob is drilled and blasted with the advance of the working place.

Man catchers are installed at each breast heading and consist of a prop set in the breast about 3 ft from the gob and connected with the gob timber with mine boards. Coal falling down the manway forms a cushion in these pockets and any material or persons falling from above are thereby deflected into the heading.

Second mining or robbing is begun immediately after the breast has reached its limit. Two or three intermediate pillar headings are driven in each pillar, similar in size to breast headings, and each block is drilled and blasted in sequence. Access to the pillar is by way of the solid side at all times and the gob is kept drawn below the level of the block being blasted.

When for any reason it becomes impracticable to win the coal by this manner, the pillar hole method is resorted to. In this method, also, the gob is kept down below the pillar being mined.

The paper continues with complete descriptions, illustrated by mine maps of several systems used in mining steep pitches, including the zig-zag-diamond method, the slant methods and modifications of the full box method.

Mining Methods in Alabama on Dipping Coal Seams

By **I. W. Miller**, General Superintendent
Black Diamond Coal Mining Company

MR. MILLER'S paper, with maps and mining plans, begins on page 26 of this issue.

Mining of Pitching Seams

By **T. H. Wilson**, General Manager
Crow's Nest Pass Coal Co., Ltd.

THE Crow's Nest Pass Coal Co., Ltd., has been operating since 1897. Its head office is at Fernie, British Columbia, and the 230,000 acres of land owned by the company are located in the Crow's Nest coal field in southeastern British Columbia. The coal in this area lies in a triangular-shaped basin with its narrow portion to the north. It has a length of about 34 miles and a maximum width in the vicinity of Fernie of 12 miles, and covers an area of approximately 230 square miles. Sections measured at different areas in this basin have shown the presence of up to 23 seams of coal, 18 of which are over 3 ft in thickness. They have an aggregate thickness ranging from 100 to 172 ft.

The company operates two collieries, one at Michel, located 23 miles north and east of Fernie, and one at Elk River, located 3½ miles east of Fernie. These two collieries produce approximately 100,000 tons per month based on a five-day work week.

The area comprising Michel Colliery is a horseshoe shape synclinal trough. The seams are cut by means of two rock tunnels; one of which is used as a main haulage and air intake. The companion tunnel is used as a main return and traveling way and also carries all mine water by means of an open ditch. It also contains two 10-in. pipe lines for 100 lb air and a 6-in. line for 800 lb air.

Most of the present day mining is on the Sparwood leg of the syncline which has an average pitch of 30 deg, with local pitches as high as 50 deg. The seam is entered from the main rock tunnel and a four-entry system is driven. The lower or main entry is driven at a grade of 0.6 percent, which is most suitable for drainage and haulage. Although full control of grade can be maintained, the line of entry must follow the lateral undulations of the seam. Generally speaking, reasonable radius of curvature can be established for the tracks without resorting to excessive brushing of floor or roof. It is standard practice to take up footwall on the high side so as to allow a flat floor 8 ft wide. Three-piece sets and a center post are used at 4-ft centers with roof and high side rib lagged with 6-ft slabs as required.

In earlier days, if the pitch was 30 deg or more, rooms were driven up the pitch with the necessary cross cuts for ventilation. At desirable intervals a track would be laid up a room and a hoist installed to haul material which was distributed by timber packers to the faces. In each room a chute would be installed which delivered coal to mine cars on the main entry. Pillars were extracted by skipping from the top of the room down. This system was undesirable for many reasons. The coal is friable with almost a complete lack of structure. With long chutes breakage was extreme, and much dust was thrown into the air. The coal either ran too fast, or stuck and required bucking.

The next step was to use belts run across the pitch to the top of a district and short splits driven up the pitch from the top belts with pillars drawn immediately on a retreat plan. Generally speaking, it was found that 750 ft was the maximum desirable conveyor length and 15 deg was the maximum belt pitch as rolling and spillage of coal occurred above that point. Actually on a 30-deg seam it was necessary to drive belt ways at 12-deg average because local variations often caused local belt pitch to increase to 15 deg in order to hold a straight line laterally. For straight line driving 750 ft became the standard length of belt conveyors, although sometimes the length is increased or decreased to meet special conditions.

The method was not satisfactory. The driving of belt ways, airways, and material roads opened up too much ground for reasonable cost maintenance; too many belts were involved with a possibility of trouble on any one shutting down a district, and the cost of conveyors was very high. It should be noted that in a district of low pitch—say 15 deg or under, where belts can be used on the full pitch—they are still preferred to any other type of conveyor. Two widths of belts are used, 26 in. and 30 in., with the latter becoming the standard.

At present two methods are generally in use. In the first, two places are driven at 60-ft centers, up the pitch from the main entry. In one place, a hoist and track is installed for hauling materials and alongside the track a Joy-Sullivan chain conveyor is installed, feeding to a loading chute at the main entry. The chain conveyors are 400 ft long and three conveyors are used in tandem. As the inclines are being driven, rooms are broken off on each side, rooms being driven and pillars immediately taken out up to the top of the district and the same system followed coming down the pitch on the other side.

At present rooms are driven 30 ft wide and a 40-ft pillar taken out on the retreat, leaving a 15-ft sacrifice pillar, so that the rooms are driven on 85-ft centers. The rooms are driven and pillars extracted with Goodman shortwalls and duckbills. Both rooms and pillars are equipped with slides on the footwall to the duckbill.

The second system in use is modified longwall. Two inclines are driven up the pitch, with chain conveyors, hoist and supply track in one incline. Two rooms are driven off the incline, at 60-ft centers; then a 250-ft block is left, and another pair of rooms driven, and this system is carried on to the top of the district.

After illustrating and describing examples of both the above mentioned systems, the paper continues:

At present production chiefly comes from an area having a pitch of about 15 deg. The actual area may be so far distant from the main entry haulage that up to six belts of 750 ft each are required to reach the district. A pair of rooms is driven at 5 deg across the pitch and a block of 250 ft left to the next pair of rooms. The rooms are driven with Goodman duckbills and shortwalls for a distance of 300 ft, with crosscuts between rooms on 150-ft centers; then a belt is installed in the lower room and the room advanced another 300 ft with the duckbill, the coal from the upper room being taken down a crosscut to the belt by a shaker conveyor (usually Mecos).

When the pitch is too great (over 15 deg) to drive raises with duckbills and shortwalls, a shaker conveyor is still used and the coal cut by air picks. The 10 ft of coal taken out is mined in two benches, the roof being lagged as the top bench is removed. A trench is cut in the middle of the bottom bench for receiving the last conveyor pan, to reduce hand shoveling as much as possible.

No electricity is allowed underground, and all machines are powered by compressed air, with a correspondingly high power cost. Ventilation requirements are rigid, as the mine is gassy; over 200,000 cfm of ventilating current is required. All rooms and entries must be bratticed from the last breakthrough to the face. The coal is friable and dusty. The main entries, traveling ways and working places are rockdusted frequently, and monthly dust samples taken for analysis, with a requirement that such dust samples show a minimum of 50 percent incombustible with an increase allowed for when gas is found or volatile content of coal exceeds 22 percent.

The collieries operate under extreme temperature variations. Thus in the winter of 1948-49 there have been 55 days below zero. Snowfall averages 13-14 ft each winter, much of which remains until the spring thaw and necessitates considerable snow removal around the surface plants. Such winter conditions call for heat drying of wet washed coal as all coal must be shipped dry.

Head office, Fernie, B C.

Utilization and Marketing

The National Fuel Reserves and Future Fuel Supplies

By **Arno C. Fieldner**, Chief, Fuels & Explosives Division, Bureau of Mines, U. S. Department of the Interior

THIRTY years ago coal was produced in the United States at nearly the same rate as in 1947. About 678,000,000 net tons were produced in 1918 and 688,000,000 net tons in 1947; 579,000,000 tons of bituminous coal and 99,000,000 tons of anthracite in 1918; and 631,000,000 tons of bituminous coal and 57,000,000 tons of anthracite in 1947. On the other hand, petroleum production has increased fivefold, and natural-gas production eightfold since 1918. The output of crude petroleum rose from 356,000,000 bbl in 1918 to 2,000,000,000 bbl in 1948; marketed natural-gas production increased from 721 billion cu ft in 1918 to 6,000 billion cu ft in 1948. In 1947, the respective energy equivalents supplied by the three mineral fuels were: Coal, 52 percent; petroleum, 34 percent; and natural gas, 14 percent.

From 1898 to 1918 the production of bituminous coal increased at an average rate of approximately 20,000,000 tons a year, reaching a maximum of 579,000,000 tons in 1918. That was the end of the rise. From that date the demand for coal wavered with the ups and downs of industry until in 1927 a decline began that ended at a little over 300,000,000 tons in 1932. During the depression, there was only a minor decline in the demand for oil and gas. These fuels had the advantage of greater convenience in use—petroleum, in particular, by the great development of the internal-combustion engine and the automobile.

The United States has large reserves of all the mineral fuels. In round numbers, the geologically inferred coal reserves in the United States are estimated at 3.1 trillion tons. This quantity is probably 40-50 percent of the world reserves of all ranks of coal. As of December 31, 1948, the proved reserves of crude oil (23.3 billion bbl) plus natural-gas liquids (3.5 billion bbl) were estimated at 26.8 billion bbl and of natural gas at 174 trillion cu ft. The United States petroleum reserves are about one-third of the world reserves. No data are available on world natural-gas reserves. The estimate of recoverable oil from oil shale in the United States has recently been increased to about 200 billion bbl.

In terms of equivalent heating values, assuming half of the coal reserves are recoverable, our fuel reserves have the following percentage distribution:

	Percent
Recoverable coal	95.5
Recoverable oil from oil shale	3.5
Proved natural gas	.5
Proved petroleum	.5
	100.0

Mr. Fieldner next dealt with the general question of conservation of coal resources and then submitted estimates on the reserves of various ranks of coal in the different fields. He further discussed briefly the possibilities of synthetic, liquid and gaseous fuels.

In conclusion, it may be said that the estimated fuel resources of the United States, as of January 1, 1949, consist of 1,552 billion net tons of recoverable coal (arbitrarily assumed to be half of the geologically inferred reserves of 3,103 billion net tons), 200 billion bbl of crude oil recoverable from oil shale and oil-sand deposits (partly measured and partly geologically inferred), 26.8 billion bbl of proved petroleum and natural-gas liquids, and 174 trillion cu ft of proved natural-gas reserves.

On the basis of equivalent energy, coal contributes 95.5 percent, oil shale 3.5 percent, petroleum 0.5 percent, and natural gas 0.5 percent. Approximately 55.4 percent of the coal reserve is bituminous coal, 24 percent subbituminous coal, 20 percent lignite, and 0.6 percent anthracite.

The highest-rank and the highest-grade coals, amounting to one-fifth of the energy content of our total coal and lignite reserves, occur in the Eastern Province, where industry and population are concentrated.

Another one-fifth occurs in the Interior Province on both sides of the Mississippi River. This coal is of lower rank, and much of it of lower grade, but almost all of it is of high-volatile bituminous rank, although less strongly coking than the Eastern coals.

Of the remaining three-fifths of our coal reserves, 75 percent consists of subbituminous coal and lignite found in the Dakotas, Montana, Wyoming, Colorado, Utah, Washington, and Texas.

All of these fuels can be converted to liquid or gaseous fuels by suitable processes. The coking types of bituminous coal have been used for many years in the gas and coke-manufacturing industries, and these have been used in commercial synthetic-liquid-fuels plants in Great Britain and Germany. Coke, anthracite, and bituminous coals are common gas-producer fuels. However, no appreciable commercial use has been made in this country of subbituminous coal and lignite for the production of producer or water gas. Processes for converting noncoking bituminous and brown coal to water gas and to a higher-Btu town gas were developed and in limited commercial use in Germany before the war.

Much research and development work is now in progress in this country by the Bureau of Mines and by several industrial organizations which should result in making these low-rank fuels useful for supplying industrial gas as well as synthesis gas for manufacturing liquid fuels, synthetic ammonia, methanol, and other chemical products. Cheap oxygen may be helpful in making possible a satisfactory commercial process.

In summarizing the bearing of our present available and future supply of fuels, it appears that we have mineral-fuel resources for 100-300 years and that we will have improving conditions of supply for the near future. Coal production has overtaken demand. Petroleum production and importation also are getting ahead of our speeding demand. Liquefied-petroleum-gas reserves are fairly large but need time to build facilities for supplying the rapidly increasing use for this convenient supplementary and peak-demand fuel. Considerably larger natural-gas reserves will be proved, and the construction of more long-distance pipelines should bring much more natural gas for industrial and public utility use as time and availability of steel permit the carrying out of present plans. There may be some tightness of supply in the immediate future.

In the long run, the increasing research and development work now in progress on gases from coal for the synthesis of liquid fuels should result in commercial processes for producing a higher-Btu gas than obtainable from the conventional gas producer. Moreover, much thought is being given and research is being initiated by several organizations on improving gas-producer equipment and processes; and finally, the new development on cheaper mining of coal by continuous mechanical methods and research on the direct use of coal in pulverized or other form should provide efficient and convenient utilization of the original Btu in the coal without losing a considerable portion of them in conversion to gaseous or liquid form.

Trends in Consumer Demand

By **George A. Lamb**
Manager, Business Surveys
Pittsburgh Consolidation Coal Co.

THE market for coal has undergone considerable fluctuation and no small amount of alteration during the last decade. It soared to record heights because of war requirements. Surprising everyone, it jumped to an all-time peak in 1947 in response to national and international postwar fuel needs. Last year, the market took a turn. Orders for coal began to lessen for the first time in years. Along with this change in volume, the market assumed a different pattern as shifts in importance of its components became clearly evident.

Not many industries have to face the wide market changes that coal does, and few could face them without falling apart as coal has not done. In spite of rises and falls since the start of World War I, coal started 1949 with its strongest peacetime position. Nevertheless, the market fluctuations and alterations remain a worry. Blame for them often is put on

that real but intangible thing called consumer demand.

What is the demand for coal that a great deal is heard about? Not so much the emotional description that the coal man is apt to give it when the market is softening: But how does demand work in the market process? First, a brief review of certain characteristics commonly associated with the term. Presenting a subject of this kind necessarily touches on abstract considerations.

Requirements for coal, oil, and other fuels originate with an economy's appetite that seems to be insatiable at times. Activities of the country's industry and civilians necessitate a huge consumption of energy which must come mostly from fuel resources.

This is a broad way of speaking of consumer demand. Fuel is ordered according to the rate of economic activity which reflects income levels as well as energy needs. Similarly, from the supply side, the operations of the economy can be no greater or expand any faster than the availability of energy permits.

Take coal demand itself. Here we come to the relationships between fuels in satisfying energy requirements. The complex economy needs a multiple of products derived from energy sources. Many forms of solids, oils, and gases in addition to electricity are needed for power and heat not to name articles used in chemical and other fields. Although components of the economy indicate the kinds and volumes of energy wanted, costs to consumer as he measures them broadly in terms of his income and expected satisfaction prompt selectivity between the different products that may be usable for specified purposes. In some cases, one product, such as gasoline for motor fuel, has a cost margin in its favor. In other cases, two or more products will have similar costs for consumer use, leaving little for choice. The demand for coal is built upon the intricacies of these conditions, defined primarily by consumers.

Important to the seller or buyer is whether or not his product has a demand that is elastic or inelastic. Briefly, an elastic demand means that price is highly sensitive in relation to sales volume. A product priced too high will be at a disadvantage in competition with other products having comparatively lower prices that can be readily substituted to the satisfaction of the consumer. Inelastic demand infers that price has comparatively little relationship to sales volume. Necessities for which there are no substitutes have demands that fall into this category. At the same time, changes in supply availability will alter demand. During the war, all fuels were in tight supply, and the demand for each tended toward elasticity. Price the resultant of demand and supply in a competitive market would have been above the level held by wartime controls. Examples are readily found of changes to elasticity in fuel demands because of expanded supplies in one or several competitive products.

The demand for coal has been considered as both elastic and inelastic. It can be shown currently that other fuels are bidding for coal business and are sometimes successful in capturing accounts. Comparative costs to consumers as between the several fuels are the determining factor in sales, indicating an elastic demand for coal. Similarly, a good case can be presented for inelasticity. Other fuels are not in a position to act as a substitute for the larger part of the coal business. Oil and natural gas do not have the facilities and resources to take over the coal market and still satisfy the requirements for motor fuel, lubricants, carbon black, and other needs. Likewise, the wholesale shift from coal to other fuels is discouraged because of the added expense in terms of new equipment. Although there may be differences of opinion regarding coal demand, it is generally conceded that the demand for total energy is inelastic. The economy must be powered and only energy can do it.

Then Mr. Lamb discussed short term and long term demands, together with the factors that would affect the energy market and the bituminous coal market. After considering the immediate future demands, he concluded:

Bituminous coal has not suffered by some developments of the other fuels. It still has good prospects in power generation, coke manufacture, and additional uses. But invasions like that of Diesel oil into the railroad fuel business or of distillate oils and natural gas into space heating are indicators of what can take place. It can be assumed that the fuel market will be even more competitive during the immediate years ahead.

Bituminous, also, can show improvement in its product. It has made advances in productivity that few other industries can match. It has been intensively engaged in bettering its products utilization. But as in the case of other fuels, coal's future will depend upon initiative and inventiveness in the making of products that will appear attractive in the ever-changing energy market.

Coal enjoys good financial health. It has a comparatively good market in view this year, and it has promising opportunities beyond. In the circumstances, it is in a position to plan carefully on its forward course. And nothing will be more helpful in this regard than a broader knowledge of consumer demand. At least bituminous should know as much about its consumers as competitors do about theirs—which it does not. Preferably, it should have a good understanding of the entire energy market.

Depreciation Allowances in Relation to New Capital Outlays

By **T. H. Bierce**, Assistant Treasurer
Rochester & Pittsburgh Coal Co.

PRICE inflation and decrease in purchasing power follow every war. The economic influences of world wars affect all countries, and the currencies of all countries are debauched to a greater or a lesser degree. No country is immune from the economic influences of world wars. In some countries the impact is more severe than in others. For example, in Greece, China, Poland, and Hungary the former currencies have practically disappeared. The degree of inflation after World War II has ranged from approximately 100 percent in the case of the United States to several hundred percent in the case of some European countries.

Capital erosion during rising price levels affects principally three items—fixed capital, inventories, and cash and cash items.

In a rapid inflation the most serious of these is the erosion of fixed capital. When physical assets have a long life, the original dollar cost may be very low, and the time lag between acquisition and exhaustion is relatively long. Recovery of original cost of fixed assets through depreciation will not only be slow but, if the price rise during this period is sharp and permanent, will be grossly inadequate.

Cash, as well as cash items such as receivables, unmatured bonds, sinking fund assets and the like, are also subject to erosion of value. As prices rise, it takes more dollars to do the same amount of unit business.

Suppose that an individual taxi driver buys a cab for $1,000, drives it for one year, supports his family and Uncle Sam's family too, and has $1,000 in cash left over at the end of the year, at which time he must replace it with a new cab. If the new cab still costs $1,000, the taxi driver's capital has suffered no erosion. If, however, a new cab costs $1,500, the taxi driver has experienced a capital erosion of $500. The earnings which he told Uncle Sam were $1,000 were really only $500 as his costs of operation were understated by an equivalent amount.

If this illustration is multiplied by thousands of employes and millions of dollars of plant and equipment purchased at various times, and if the recovery of investment through depreciation is extended to cover 20 or 30 years of operations, we have a situation which is comparable to the average complex business operation. For purposes of depreciation allowances, however, as well as their relation to new capital outlays, the principles and problems are exactly the same. If dollar purchasing power declines sharply between acquisition date and replacement date, we find understated costs, overstated income, and taxes and dividends paid out of capital. In short, erosion of capital takes place.

For corporations alone, the Department of Commerce has officially estimated that, of the $79 billions of profits reported from 1941 to 1947, nearly $16 billions were not profits at all but merely increased prices for the same quantities of inventories. During the same period, cash and receivables lost approximately one-half of their value. Plant and machinery under usual accounting practices have been depreciated on the basis of original cost so that the amounts deducted in figuring profits are approximately one-half what they would have been if figured on current values.

The mining industry is particularly concerned with problems of capital erosion and plant replacement, since a large part of its property is composed of depreciable assets of relatively long life. Many of these assets entered service long before present price levels appeared. Moreover, the recent introduction of the continuous miner may accelerate obsolescence factors on other equipment.

The magnitude of the problem, therefore, is great, and the consequences of failure to effect its solution are appalling. The subject of adequate depreciation in relation to new capital outlays demands the immediate attention not only of accountants but also of top management and taxing authorities, as well as the sympathetic understanding of stockholders, customers, and all employes whose livelihood depends upon maintenance of productive capacity.

Depreciation, therefore, should not be limited to original cost. In order to maintain jobs for the same number of workers, depreciation policy must swing over to some form of replacement basis.

The Tax Committee of the American Mining Congress has made two valuable

suggestions which we believe should be taken into account by our tax laws:

(1) The decreasing balance method of computing depreciation, if permitted, would provide for the allowance of greater depreciation in the earlier years when economic usefulness is said to be greatest. This method would reduce exposure to capital erosion.

(2) The depreciation base should not be decreased if the depreciation to be written off cannot be applied against taxable income. This proposal would eliminate that portion of capital erosion arising from the deduction of depreciation in loss years.

Summary

In the present stage of inflation, therefore, the following general thoughts on depreciation allowances in relation to new capital outlays may be helpful:

(1) *As to Accelerated Depreciation*

(a) Accelerated depreciation, either for book or for tax purposes, cannot possibly prevent erosion of capital because it does not bridge the gap between original cost and replacement cost.

(b) Accelerated depreciation will quickly increase the proportion of fully depreciated assets still in service.

(2) *As to Depreciation on Replacement Cost*

(a) Since depreciation, on a replacement cost basis, without asset revaluation, has not yet been generally accepted, companies should now consider the advisability of revaluing all assets at the new price level and booking depreciation on the revalued basis, in accordance with the provisions of Accounting Research Bulletins No. 3 and No. 5.

(b) When the assets have been so revealed, depreciation on the revalued basis should be deductible for tax purposes, in order to permit profit accumulations adequate to maintain productive capacity at replacement cost.

(3) *As to Tax Laws*

(a) Tax laws should take into account as quickly as possible the problem of replacement of physical facilities at current price levels.

(b) Tax laws should encourage the use of the decreasing balance method of computing depreciation.

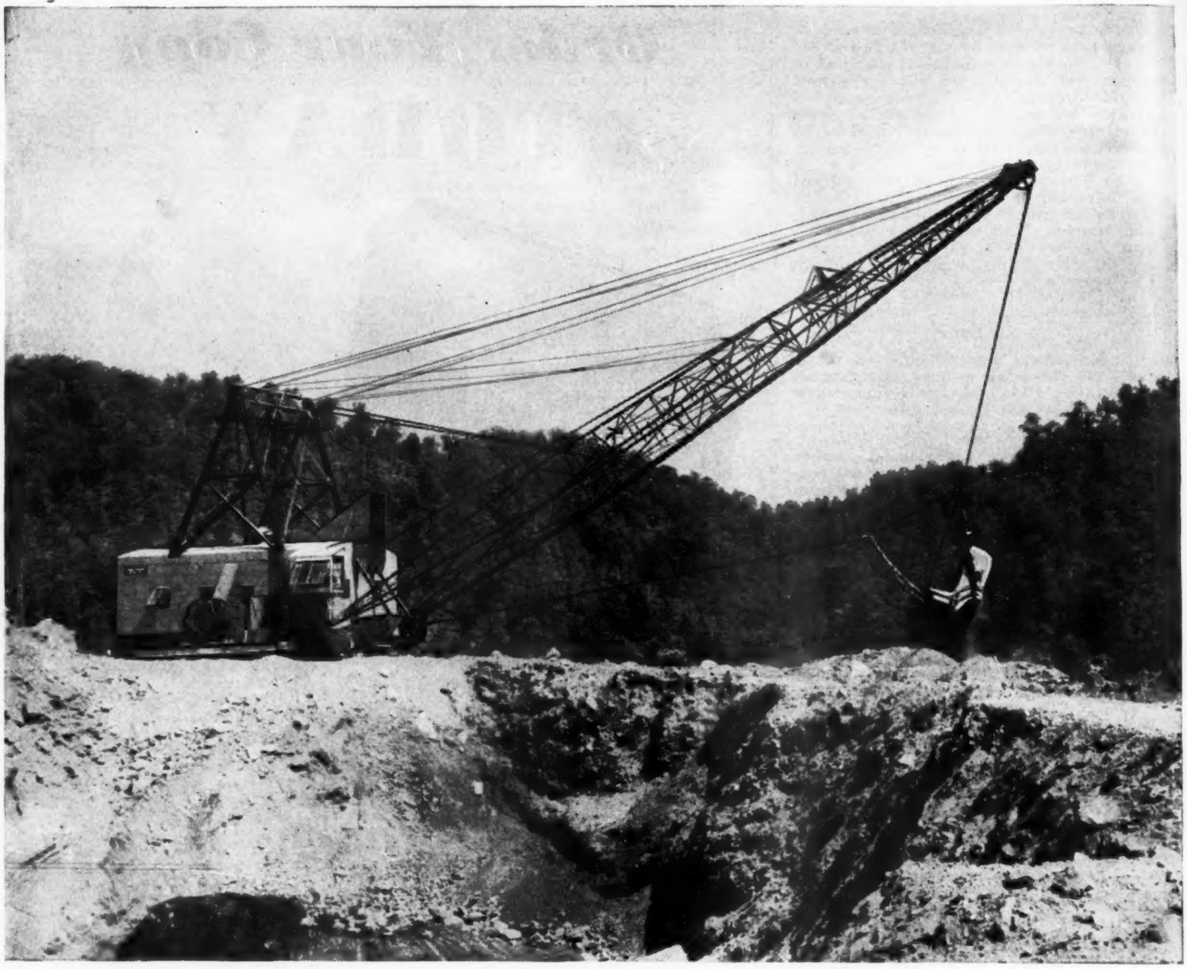
(c) Tax laws should recognize the desirability of eliminating depreciation deductions in loss years, and thus prevent capital erosion caused by failure to recover total original cost.

(4) *As to Pricing Policies*

(a) Regardless of what is or is not done with respect to depreciation policies and tax laws, business can prevent further capital erosion by setting selling prices at a level high enough to provide profit accumulations, after taxes and dividends, which are adequate to provide capital replacements at the present high price level. This should be done on an industry-wide basis, and should be done now. To delay until tax laws and accounting concepts are modified would merely continue the present ruinous rate of capital erosion.

(5) *And Lastly—*

(a) Business is entitled to assert its right to protection from capital erosion, in order to preserve its own corporate existence. Management generally recognizes this problem. Stockholders and employes must be made to appreciate more fully than ever the consequences to them of failure to maintain productive capacity out of accumulated earnings. The maintenance of productive capacity is a prerequisite to the freedom and the opportunities which we hope will always be ours.



WHEELS OF GOVERNMENT

As Viewed by A. W. DICKINSON of the American Mining Congress

AFTER a White House conference May 24, Congressional majority leaders predicted adjournment of Congress by July 31. Slated for action by Senate Majority Leader Scott Lucas of Illinois were Reciprocal Foreign Trade Agreements extension, changes in the Taft-Hartley law, and ratification of the North Atlantic treaty. House leaders expect the work of their chamber to be finished soon after June 30. There is now less talk of a fall session of the Congress.

Minority leaders voiced sharp criticism of a bill introduced by Representative Mills (Dem., Ark.) to balance the Federal budget for the fiscal year ending June 30, 1950, by requiring corporations to pay their 1949 income taxes in the first six months of 1950, instead of spreading installments over the 12-month period. The White House has indicated its approval of the idea but still insists that taxes should be increased.

Labor Bill

On May 4, by a vote of 212 to 209, the House recommitted to its Labor Committee the bill by Representative Wood of South Carolina, which by a vote of 217 to 203 had been substituted for the Administration's Lesinski measure. In the course of the hot debate three major amendments had been added to the Wood bill, providing (1) that the NLRB general counsel, before he may seek a temporary injunction in an unfair labor practice case, must make an investigation, issue a formal complaint, find a threat of irreparable injury to exist, and take into account the public interest; (2) an extension to six months of the period in which employes on "economic" strikes retain their right to vote in NLRB elections; and (3) a relaxation on the ban on union secondary boycotts so as to allow employes to refuse to handle "struck-work"—that is, work which employes of another employer are legitimately refusing to do.

Previously, Speaker Rayburn, in an effort to save the Administration bill, had approved the inclusion of the Sims (Dem., S. C.) amendments, but even with this concession the bill was voted down by the Republican-Southern Democrat coalition, 211 to 183. The Sims amendments included free speech, non-Communist affidavits, financial reports of labor organizations to union members and the public, bargaining in good faith, and injunction and plant seizure powers in strikes involving the public welfare.

House leaders now state that a rewritten bill will be submitted for floor action around mid-June.

In the upper chamber minority Senators Taft of Ohio, Smith of New Jersey and Donnell of Missouri on May 4 submitted a report carrying a compromise bill which they feel that the Senate will approve. The measure retains a substantial part of the basic features of the Taft-Hartley Act, but among other concessions eliminates the independent status of the NLRB general counsel; makes employes on strike eligible to vote even if not entitled to reinstatement; repeals the mandatory provision that the NLRB seek temporary injunctions, with complete priority to such action; no longer requires joint control of welfare funds if the employer does not desire it, and removes criminal liability if the Secretary of Labor approves the terms of the welfare fund; provides that in a national emergency strike the President may call on the employer and employes to continue to work before appointing a Board of Inquiry; permits the Board of Inquiry to make definite recommendations; and if the strike or lock-out continues, provides for either injunctive procedure or plant seizure, or both.

It will be remembered that the Administration's Thomas (Dem., Utah) bill, repealing the Taft-Hartley Act and reenacting the Wagner Act, was reported to the Senate without amendment. Senate Majority Leader Lucas has announced that floor debate on the bill will begin early in June and is expected to run for two or three weeks.

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Washington Highlights

CONGRESS: Sets sights for July 31 adjournment.

LABOR BILL: Receives setback in House.

WAGE-HOUR: Leaders talk simple increase in minimum wage.

OVERTIME-ON-OVERTIME: Now in conference.

ASSESSMENT WORK: Another moratorium?

INCENTIVE PAYMENTS: Engle reports measure.

GOLD: Hearings on free market.

BASING POINT: Moratorium expected.

COAL: Southern producers negotiate.

★ ★ ★ ★ ★ ★ ★

Wage-Hour

The Senate Committee on Education and Labor has taken no further action on amendments to the Wage-Hour Act since the conclusion of hearings in late April. In the House the majority leaders have apparently abandoned plans to pass broad amendments to the Act and are centering on efforts to merely increase the minimum wage to 75c an hour, or perhaps less. Discussed in the May JOURNAL was the bill by Representative Lucas of Texas which the Southern Democrat-Republican Coalition will try to substitute for the Administration measure. This bill makes provision for clarification of the term "regular rate of pay" and would establish a 65c minimum wage to be adjusted upward or downward in accordance with the cost of living.

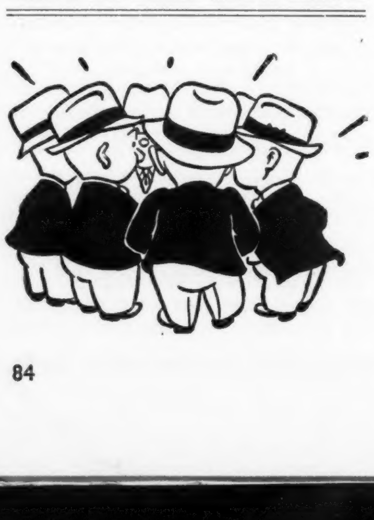
Overtime-on-Overtime

It is expected that conferees will be appointed to consider the overtime-on-overtime bill, H. R. 858, which the Senate finally passed on May 17. The Senate version applies to all industry retroactively with no cut-off. As the measure originally passed the House it applied only to the longshore, stevedoring, building and construction industries and would have applied only to future claims for overtime-on-overtime. It excludes from the regular rate of pay, for purposes of overtime compensation, premiums paid for Saturday, Sunday and holiday work and for work at undesirable hours.

In reporting the bill the Senate Committee said, "We believe that the overtime-on-overtime claims cannot be distinguished from the claims covered by the Portal-to-Portal Act. In both cases the claims arose under the Fair Labor Standards Act and would not have existed were it not for that law; in both cases, the claims arose by reason of the failure of Congress to define a basic term in that Act—the 'workweek' in the portal-to-portal situation and 'regular rate' in this overtime-on-overtime situation; in both cases, prosecution of the claims violated the spirit of collective-bargaining agreements; in both cases, the filing of suits was deplored by responsible A. F. of L. officials; in both cases, the collection of claims would unfairly penalize employers who attempted in good faith to comply with the wages-and-hours law. Indeed, in every important respect the overtime-on-overtime claims closely parallel the portal-to-portal claims. In our opinion, the factual and legal findings recited in the Portal-to-Portal Act are equally applicable here, and the situation requires the same expeditious and equitable treatment by Congress."

Assessment Work

Slated for conference consideration is the Granger bill, H. R. 1754, which as passed by the House would have extended from July 1, 1949 to October 1, 1949 the time within which this year's assessment work must be performed. The Senate Committee on Interior and Insular Affairs amended the bill to provide a renewed "moratorium" or suspension of assessment work for one year until July 1, 1950. Another amendment added would make the claimholder liable for any damage that may be caused to the value of the land for grazing. Both of these amendments are undesirable and House conferees are definitely opposed to them. It is possible that a compromise may be worked out under which the bill would be confined to an extension until January 1, 1950 of the time in which this year's assessment work must be performed.



Incentive Payments

The House Public Lands Committee has ordered the Engle Mine Incentive Payments bill, described in the May JOURNAL, reported to the House, but has stricken the requirement that the Bureau of Federal Supply reimburse RFC in the amount of the current market price for ores, metals, and minerals placed in the national stockpile. This would require that appropriations be made for the Department of Interior to finance purchases. Hearings are anticipated in the Senate before an Interior and Insular Affairs subcommittee on the Murray-Hayden-McFarland bill, which has been amended to make it identical in form to the newest version of the Engle bill.

Another bill by Representative Engle, amending the Contract Settlement Act of 1944 to authorize payments to persons who had contracted to deliver strategic and critical minerals or metals to the Government but who failed to recover their expenditures for this purpose, is subject to early House floor action under a rule.

Gold Hearings

In early May the Senate Committee on Banking and Currency conducted hearings on the McCarran (Dem., Nev.) and Johnson (Dem., Colo.) bills to authorize the unrestricted sale of gold within the United States or for export. In addition to Senators McCarran and Johnson, Representative Clair Engle (Dem., Calif.) and Delegate Bartlett of Alaska advocated passage of a measure to accomplish this objective. A number of economists, bankers, and qualified mining men testified in support of the bills; other economists registered opposition while calling for the Government to return to the gold standard.

Joseph Stagg Lawrence, vice-president, Empire Trust Co. and consultant to the American Mining Congress Gold Committee, declared that the creation of a free market for gold will provide a practical intermediate step between the fiat currency basis prevailing today and that fixed gold monetary unit freely circulating, which is the authentic mark of a real gold standard. Dr. Donald H. McLaughlin, president, Homestake Mining Co., explained to the Committee that with gold in a free market the Government would have an empirical way of determining where gold stands in relation to the dollar. He said he would prefer to have gold come back into circulation in the form of coin that would be labeled "one ounce of gold," with no dollar sign on the coin at all. Fred Searls, Jr., president, Newmont Mining Co., gave his opinion that a free market in the United States would not greatly increase the price of gold and that the prediction of price increase is greatly over-estimated.

Basing Point

The Senate on June 1 passed an amendment by Senator O'Mahoney (Dem., Wyo.) as a substitute for the Myers (Dem., Pa.) bill which would have granted a moratorium until July 1, 1950 on any new Federal Trade Commission cases against good-faith freight absorption. The O'Mahoney version is a permanent measure intended to remove any doubt concerning the legality of freight absorption or delivered price systems, if not used as a conspiracy to restrain trade. On the House calendar is a bill by Representative Walter (Dem., Pa.) which would grant a moratorium from March 1, 1949 to July 1, 1950 on new FTC cases against good-faith freight absorption.

Impetus has been given to the need for this legislation by the U. S. Supreme Court decision of April 25 upholding the FTC order against the basing point price system for rigid steel conduit manufacturers.

Coal Contract

Contract negotiation meetings on May 25 and 26 between the Southern Coal Producers Association and the UMWA in Bluefield, W. Va., resulted in an adjournment of one week when UMW president John Lewis questioned the authority of the Association to fully represent the tonnage in its membership. Lewis charged that "companies producing tonnage of magnitude have withdrawn bargaining rights from this Association." Lewis also made the statement that, "We understand that so long as Mr. Moody (SCPA president) holds bargaining rights under the Taft-Hartley Act, we are not legally free to accept into conferences elsewhere any representative of coal companies having mines in areas where they are members of Mr. Moody's Associations."

In mid-May Lewis had written to Harry M. Moses, president, H. C Frick Coke Co., offering to meet in discussions on a new coal contract. Moses has recently made public his reply to Lewis stating: "When we

(*Continued on page* 108)

Personals

Horace M. Albright, president, United States Potash Co., was elected chairman of the National Minerals Advisory Committee. He succeeds **Donald H. McLaughlin**, president, Homestake Mining Co.

The National Coal Association board of directors has elected **L. Russell Kelce**, Kansas City, and **Joseph T. Berta**, Philadelphia, to the board. Mr. Kelce recently became president of Sinclair Coal Co. and has been associated with that company since 1924. Mr. Berta is president of the Pennsylvania Coal and Coke Corp., directing bituminous coal mining operations and managing the company's sales program. The two men succeed Grant Stauffer and Charles O'Neill, former directors of the NCA board, who died early this year.

John G. Reilly has resigned as general manager of the Bayard Department of the United States Smelting Refining and Mining Co., effective May 21. He will enter the consulting field and will continue to maintain his residence at 407 College Avenue, Silver City, N. M. Mr. Reilly was formerly managing director of Compania Real del Monte y Pachuca at Pachuca, Hidalgo, Mexico.

Dr. James Boyd, director, U. S. Bureau of Mines, delivered the commencement address at Montana School of Mines on the evening of June 10.

The Union Pacific Coal Co. has announced the following appointments: **Joseph Q. Berta**, mine superintendent, Superior, Wyo.; **Tony Taucher, Jr.**, assistant mine superintendent, Superior, Wyo.; **Robert Bowie**, assistant mine superintendent, Stansbury, Wyo.; and **Lawrence Welsh**, assistant mine superintendent, Reliance, Wyo.

O. W. Tuckwood, American Smelting and Refining Co., has been elected vice-president in charge of traffic. Mr. Tuckwood was a former general traffic manager. He served as chairman of the nation's lead producers' traffic committee in appearances before the Interstate Commerce Commission, representing mining interests in connection with increased freight rates.

J. P. Williams, Jr., chairman of the board of directors of Koppers Co., Inc., has retired from active management of the company after an association of nearly 30 years. Mr. Williams will remain as chairman of the board of directors and will serve the company in an advisory capacity.

Francis O. Case, of Greenwich, Conn., has been elected a vice-president of Anaconda Copper Mining Co. Mr. Case has been associated with Anaconda since 1920.

A. J. Christiansen, 307 North Michigan Avenue, Chicago, has been appointed secretary-treasurer of the Illinois Coal Strippers Association. He succeeds the late J. W. Bristow.

Jean McCallum retired from service with the National Lead Co. on May 1, completing a period of almost 31 years. He first joined the National Lead Co. in 1918 after varied experience gained following his graduation from the Colorado School of Mines in 1910. In his years of service with the company he held supervisory positions at the Florence, Colo., plant, the Collinsville, Ill., plant, and at the St. Louis, Mo., division of National Lead. In 1947 he was made general manager of the Texas Mining & Smelting Division of National Lead in addition to his position as manager of the St. Louis Smelting & Refining Works.

Mr. McCallum plans to remain in St. Louis to do consulting work at 722 Chestnut St.

Harry L. Kirkpatrick of the University of Kentucky and **Alvey B. Rushton** of Lehigh University have been honored by the Old Timers Club for scholastic excellence in coal mining. **George R. Eadie** was cited as the most outstanding mining graduate of the year.

James E. Stewart, formerly of Bisbee, Ariz., has been named manager of the U. S. Atomic Energy Commission's area office at Schenectady, N. Y. In this position he serves as the AEC representative at the Knolls Atomic Power Laboratory, operated for the AEC by General Electric Co. and experimenting in the uses of atomic power.

R. C. Collier has been transferred from his post as mine foreman of Mine 207, Consolidation Coal Co. (Ky.) to mine foreman of the new Hendrix Mine at Deane, Ky. **R. D. Kyl** has been promoted from assistant mine foreman to mine foreman of Mine 207, Dunham, Ky.

Walter Waidler of Vanadium, N. M., has been named superintendent of American Smelting and Refining Co.'s Trench mine near Patagonia, Ariz. He succeeds **Wendell T. Brown** who has been transferred to South America to serve as ore buyer for the company.

Paul M. Tyler has been appointed minerals consultant for the Joint Congressional Committee on Foreign Economic Cooperation and is now in Europe studying ECA activities. Before returning to Washington in the fall, he expects to visit several projects in the Near East and Africa.

Earl K. Nixon, geologist with the State Geological Survey at the University of Kansas, will spend the summer in Alaska and the Yukon doing mine examination work.

George Phillips has been promoted to the post of safety inspector at the Wolf Run mine, Warner Collieries Co. **George Weals**, formerly assistant mine foreman, succeeds Mr. Phillips as mine production foreman.

Norman Ebbley has been appointed resident manager of the King Lease, Inc., operating the Camp Bird mine at Ouray, Colo., by the Minerals Engineering Co., consulting managers of the property. Under the direction of **Blair Burwell**, president, the managing company is planning an increase in tonnage at the mine and mill.

Homer Crank has been promoted to the position of superintendent of Mine No. 30 of the Black Mountain Corp. at Kenvir, Harlan County, Ky.

A. J. Morrison has been appointed manager of the shaft and tunnel department of Dravo Corp.'s contracting division, Pittsburgh, Pa.

J. P. Skinner, U. S. Bureau of Mines engineer from Birmingham, Ala., has been transferred to the Duluth, Minn., offices.

W. J. O'Connor, general manager of the Utah department of the American Smelting and Refining Co. retired on May 1. He has been with AS&R for 39 years, 32 of them in Utah. **R. D. Bradford** of San Francisco succeeds him. Mr. Bradford started with the company in 1926 and has worked in the company's New York, East Helena, Mont., and El Paso, Texas, operations.

J. H. Williams has joined the staff of the Fairmont Coal Bureau as fuel engineer, effective April 16. Mr. Williams was closely connected with the bituminous coal industry as a test engineer in the Cleveland area during the early years of his career. For four years during World War II he was in charge of engineering, construction and operation of several Ordnance Division plants. Since the war he has been a consulting engineer in the power field with both Gilbert Associates and Burns & Roe, Inc.

Walter P. Carroll, a director and manager of the Chicago Branch of National Lead Co., has been elected a vice-president of the company. **C. F. Garesch** has been named chairman of the newly-formed research control committee of the company. **D. W. Robertson** succeeds Mr. Garesch as general manager with **J. H. Reid** taking over as division manager.

In the St. Louis smelting and refining division of National Lead, four executive changes have been announced. **G. M. Wiles** has been appointed division manager; **A. R. Reiser** has been appointed assistant division manager; **H. A. Krueger** has been named plant manager of the Tri-State operations of the division; and **A. J. Yahn** has been appointed plant manager of the division's Fredrickstown operation.

John W. Abrell, superintendent of mine No. 8, Peabody Coal Co., Tovey, Ill., has been appointed superintendent of the company's new mine at Pana, Ill.

Stanley A. Mahon, Jr., has been appointed superintendent of the Weggum Mine of M. A. Hanna Co. in Minnesota. He was previously at the M. A. Hanna Co.'s operations in Labrador and at Spring Valley.

John M. Kerr has been named general manager of Berwind-White Coal Mining Co., Windber, Pa. He was formerly general superintendent.

John W. Newett, of the engineering and operating department of the Phelps Dodge Corp. at its New Cornelia copper mining branch at Ajo, Ariz., has been appointed chief engineer.

Paul B. Entrekin, former vice-president and manager of Bethlehem Chile Iron Mines, has been appointed general manager of the mining division of Bethlehem Steel Co.

J. P. Weir is now associated with his father, **Paul Weir**, in serving the coal industry as consulting mining engineers.

Frank R. Milliken has been appointed assistant manager of National Lead Co.'s Titanium Division with headquarters in New York City. **George W. Wunder** succeeds him as plant manager of the MacIntyre development at Tahawus, N. Y., and **Paul W. Allen** becomes assistant plant manager there.

Joseph L. Walker, Jr., is now research mining engineer with the Rimersburg Coal Co., Rimersburg, Pa.

Dr. S. C. Ogburn, Jr., manager of research and development for the Foote Mineral Co. of Philadelphia, Pa., has been appointed a director of that firm. Dr. Ogburn will continue to spark its accelerated research and development program, emphasizing product evaluation and market applications of materials.

Harold L. Beattie has been named general superintendent of the West Virginia operations of the Warner Collieries Co., Cleveland, Ohio.

Thomas F. Kearns was reelected president of Silver King Coalition Mines in May. Others named were **James Ivers**, vice-president and general manager, **M. G. Heitzman**, manager of operations, and **S. B. Lamkin**, secretary-treasurer. In addition to these, other directors elected were **J. F. Fitzpatrick, J. T. Harris, W. J. O'Connor, D. J. Pope, W. R. Landwehr, and David Keith, Jr.**

H. L. Francis has been appointed eastern traffic and transportation manager for Koppers Co., Inc.

Kenneth C. Brownell, of New York, succeeded his father, Francis H. Brownell, as president and chairman of the board of directors of the Federal Mining and Smelting Co., operator of the Morning, Frisco, and Page mines of the Coeur d'Alene district of Idaho.

Charles E. Stott, formerly vice-president and general manager of Compania Minera de Penoles, S. A., and Compania Metalurgica Penoles, subsidiaries of the American Metal Co., Ltd., is now located in Washington, D. C., as regional specialist with the strategic materials division of ECA, covering Africa.

— *Obituaries* —

Arthur Berkley Yates, 47, former chief geologist of the International Nickel Co., died May 10 in Montreal, Canada. Dr. Yates had been stationed in South Africa and was in Montreal to receive the Barlow Memorial Medal of the Canadian Institute of Mining and Metallurgy.

Dr. Yates was born in Lead, S. D., in 1901. He received a B.S. degree in mining from the University of California in 1922. He was employed by the Homestake Mining Co. as surveyor, engineer, and geologist from 1923 to 1928. Dr. Yates then studied at Harvard Graduate School from 1928 to 1931 and received his Master's and Doctor's degrees in geology and mining engineering. He was a research associate at Harvard University for three years before becoming associated with International Nickel.

Dr. Yates was a member of the Canadian Institute of Mining and Metallurgy, a fellow in the Royal Society of Canada, a member and on the Council of the Society of Economic Geologists, and a fellow of the Geological Society of America. He was the author of many articles on geological subjects.

John G. Kipp, former New York district manager of the Elreco Corp., died on May 6 after a long illness. Mr. Kipp had been associated with the Elreco Corp. for 54 years.

James W. Bristow, secretary and treasurer of the Illinois Coal Strippers Association, died April 13 in Chicago. For the past 11 years, Mr Bristow's work with the association was devoted largely to the improvement of public relations of coal strippers in land reclamation work. Prior to that time he was with the Illinois Reciprocal Trade Association.

Col. **Harry Howard Stout**, 77, died at Plainfield, N. J., on April 13, following an illness of several months. Colonel Stout was superintendent of Phelps Dodge Corp.'s Copper Queen smelter at Douglas, Ariz., from 1917 to 1921. He then was transferred to the company's New York headquarters and served as consulting metallurgist until his retirement in 1931. Colonel Stout was a graduate of West Point and served in Cuba during the Spanish-American War and in France during World War I. Burial was in Arlington National Cemetery.

Paul A. Gow, president and general manager of the North Butte Mining Co. and a prominent resident of Butte, Mont., for many years, died on April 27. He was also president of the Unity Gold Corp. of Cripple Creek, Colo.

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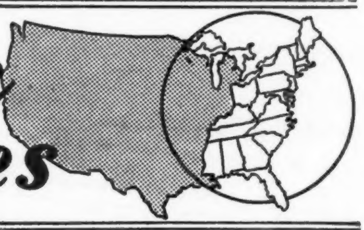


Bureau of Mines Research

On the occasion of the 100th anniversary of the Department of the Interior, visitors to the open house held at the Eastern Experiment Station, Bureau of Mines, College Park, Md., were able to see many of the important basic research developments being undertaken. Among the experiments in operation are the electrostatic separation of zircon and other sands. The rolling of titanium metal is particularly interesting in that the powdered metal must be encased in a sheath of mild steel before it can be reduced. After being welded in the steel container, the billet is heated to about 800-900 C and rolled. At the completion of the rolling operation the iron sheath is removed by shearing and is pried from the finished metal. Then the titanium sheet can be reduced further by cold rolling to give the surface a good finish. The photographs below show a partially rolled sheet being measured for the amount of reduction.

Coal Flotation with Kerosine

Sloss-Sheffield Steel & Iron Co., Birmingham, is using kerosine-flotation at their Kimberly mine. The method is similar to that used at the Bessie mine as described in the March issue of the MINING CONGRESS JOURNAL.

Minable Coal in Alabama Field

Minable coal deposits have been discovered in the Coosa field of St. Clair County, Ala., by the Bureau of Mines. Commercial development of the reserves could conserve large amounts of the state's valuable coking coal, the Bureau says. Alabama's principal coking coal reserves are in Warrior field but much of this field is being used by railroads, industrial and domestic consumers instead of being manufactured into metallurgical coke.

Mine Inspectors Meet

The Mine Inspectors' Institute of America held its annual convention in Pittsburgh, Pa., on June 13, 14, and 15.

The Monday session was devoted to recent developments in American glass manufacture, safety of continuous coal mining machines, and control of fires and dust particles in mines. The most recent developments in roof suspension were discussed on Tuesday, and a visit was made to the Mine Safety Appliances Co. Rockdusting was discussed on Wednesday and the convention closed with the annual banquet and dance.

Electrostatic concentration of zircon sands

Sheath rolling titanium

MODERN MINE standardizes on BOWDIL

BITS, CHAINS and CUTTER BARS

WYOMING MINING CORPORATION
GENERAL OFFICES
LYNCO, WEST VIRGINIA

The Bowdil Company
Canton, Ohio

Attention: Mr. Charles Bowman

Dear Mr. Bowman:

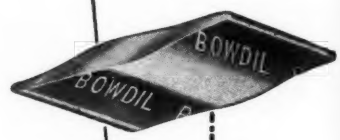
We started using your bits about ten years ago and found them to be so satisfactory that we started to use your bars and chains, and the results have been such that we have standardized on them on all of our cutting machines.

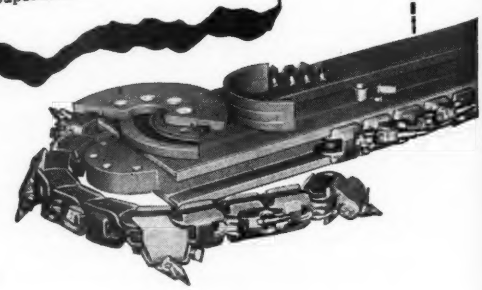
Yours very truly,

Wyoming Mining Corporation

G. E. Minns

G. E. Minns, Superintendent





At Lynco, model mechanized mine of the Wyoming Mining Corporation, you find Bowdil equipment on all cutting machines. Here's why:

BOWDIL FABRI-FORGED CHAIN circles cutter bar at correct angle because of Bowdil's true running track guide. Drop-forged lug body stands up under heavy wear—is built for many times the normal load. Chain is easy to connect, remove or replace.

BOWDIL CUTTER BARS are specially made for coarse cutting. Built of high physical alloy steels, their rivet-free design gives them greater strength than conventional bars. They fit all types of machines.

BOWDIL CUTTER BITS save power—have 25% more wearing length—give 15% to 20% longer life.

Bowdil Equipment can help you increase mine efficiency and reduce operating costs. Get complete details. Write.

THE BOWDIL COMPANY
CANTON, OHIO

BCR Considers Future

More than 300 leading coal and railroad companies joined Bituminous Coal Research, Inc. in considering the status of their present projects and plans for future research at the annual meeting of BCR in Columbus, Ohio, May 18.

The main sessions of the meeting were devoted to discussions on technical and economic aspects of the research projects now being conducted and the cooperative research which can best satisfy industry needs. Coal executives described the methods used in producing fuel gas from coal. New methods to reduce the cost of coal to consumers were also discussed. A tour was made of the Battelle Memorial Institute where a major portion of the BCR research is conducted.

New "High" at Republic Steel

All-time high marks during the month of March were recorded at the huge mining operations of Republic Steel Corp. at Mineville, N. Y. Production of 230,773 gross tons of magnetite ore in the company's Old Bed, Fisher Hill, and Harmony mines was one of 14 new production records set for the month.

Safety Results

In February 1949 nation's bituminous coal mines achieved their second best safety record in history. The number of fatal accidents was less than one-half what it was the same month of 1948, and the rate was nearly 40 percent less than for all of last year—when the coal industry set a new safety record.

Likewise in January 1949 the safety figures were considerably better than average and approximately 10 percent better than the mark for all of 1948. Thus the bituminous coal industry is maintaining the long-term trend that has made coal mining more than twice as safe as it was 40 years ago.

New Island Creek Mine in Production

Island Creek's newest operations, Mine No. 27, located in Mingo County, W. Va., shipped its first coal during April. Production of the coal, a multiple-bedded gas and splint mixture, is expected to reach 4000 tons a day. The coal has a firm structure, does not break easily, and screens into a number of sizes for domestic and steam use. It is especially adapted to the manufacture of gas and other special purposes.

Annual Anthracite Conference

The Seventh Annual Anthracite Conference held under the auspices of Lehigh University in Bethlehem, Pa., May 5-6 featured conferences on research, mining and preparation, utilization, and retail anthracite problems.

The latest developments in anthracite for commercial plants and homes were described by William Stein of Combustion Engineering-Superheater, Inc., New York, N. Y. A new traveling grate machine and anthracite underfeed stokers have been chief factors in the increasing use of anthracite stokers. John W. Buch, U. S. Bureau of Mines, surveyed progress in the mechanization of mining at one of the sessions of the Conference. Retail problems confronting anthracite dealers were discussed at the closing session.

Salt Dome Discovered

A huge salt dome was discovered in the southern part of Alabama. The interesting geological feature of the dome is that it is within 400 ft of the surface and is near a navigable river.

Alabama Strip Iron Mine

Joe McCullough Stripping Co. began production of hematite iron ore from a property near Compton, Ala. The property was mined by hand methods years ago and lends itself to present-day stripping methods.

A 5-cu yd shovel is used to remove the overburden and a 1½-cu yd shovel to mine the ore. Present daily production is about 500 tons of ore averaging 52 percent iron, all of which is shipped by rail to the Birmingham furnaces.

Mine Training Course

West Virginia School of Mines began a six-weeks' course in mining at Morgantown, Beckley, and Logan on June 6. The course provides training for foreman and fire boss candidates who wish to gain certificates in these fields and offers an opportunity for mining men to study the technical phases of coal mining.

Roof Bolting Proves Successful

Tennessee Coal Iron & Railroad Co. is rapidly converting all their producing iron ore mines to using the roof bolting method of support. Experimental work has proven the method most successful, safe and economical. Roof bolting is also being extensively applied in the company's Concord coal mine, which is the only coal mine in the Birmingham district reported as using the method.

Old Producer Plans Operation

The abandoned Haws I mine of the Gibbs Coal Co., located on the fringe of Hollsopple, Somerset County, Pa., will be reopened soon according to Harry Kohler, Bennscreek, Pa., the new lessee. Abandoned for several months the mine is now being prepared for resumption of operations by Mr. Kohler and a crew of workmen. The first output will be trucked into Johnstown, Pa. or to railroad ramps.

ECA Aids Norway

Under a technical assistance project designed to help Norway rehabilitate mines destroyed during the war, two officials of the Sydvaranger A/S Iron Mines in northern Norway are spending six months in the United States studying mining methods and equipment which might be adapted in Norwegian mining operations. They are Arne Stavang, superintendent of Sydvaranger's agglomerating plant, and Arne Hofseth, chief mine superintendent.

Two-Mile Tunnel Begun

Construction on the river end of the two-mile conveyor tunnel at the Morgantown Mine of National Steel Co. near Morgantown, W. Va., will begin soon. Equipment, including shuttle cars and a continuous miner is being installed. Construction of the main administration building is under way. This new mine with a projected capacity of 4200 tons per day has an estimated life of 35 years. It is expected to be in operation in January 1950.

Mineral Producers Plan Meet

The annual meeting of the Mineral Producers Association will be held Friday, June 24, at the William Penn Hotel, Pittsburgh, Pa. The afternoon session will be given over to a discussion of problems affecting the coal industry. At 7:00 p. m. the annual banquet will be held.

Fine Iron Ore Tests

A new method of utilizing extremely fine sizes of iron ore in blast furnace operations is being explored by the Pittsburgh Consolidation Coal Co., the National Steel Corp., and the M. A. Hanna Co. near Imperial, Pa. A variation of the Disco smokeless fuel process is being used in this developmental work. An increase in this fine-sized iron ore is expected because of the steel industry's growing dependence on lower-grade ore deposits, that must be finely ground and beneficiated.

Coal Experiment Station Proposed

Legislation to authorize building of a new million dollar experiment station near Morgantown, W. Va., to conduct research in mining and the use of coal and other materials, has been introduced by Senators Kilgore and Neely.

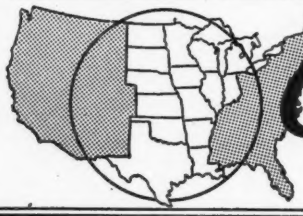
Mill Measurement and Control

(*Continued from page* 37)

been applied as a means for the automatic control of a grinding unit. Considerable time has been devoted to the study of the problem and some of the findings may be of interest.

In connection with the discussion of pH measurements it was shown that flotation circuits were "feedback" circuits. It was also shown that capacity, transfer, and transportation lags were troublesome. At the Pioche mill a certain portion of the cleaner tails are returned to the bill mill discharge launder. Sometimes due to a change in character or grade of ore the classifier overflow is not properly ground even though the specific gravity of the classifier overflow remains constant. This poorer grind is reflected in the flotation circuit by an increase in middling return to the classifier. The increased velocity of pulp through the classifier, due to this increase in middling return, tends to wash through the classifier resulting in a decrease in rake load while the specific gravity of the overflow changes but little. The action of a controller operating on the overflow density or the rake load or both under these conditions would be to increase the feed to the ball mill thus aggravating the condition. Something in addition to classifier rake load and/or overflow specific gravity is needed to affect the automatic control of a grinding unit.

Experience indicates that more and better instruments are needed. These instruments will have to be developed by the mineral industries, at least in principle. Each mill is a separate problem, therefore automatic control must be approached cautiously and only after much measurement throughout each plant.



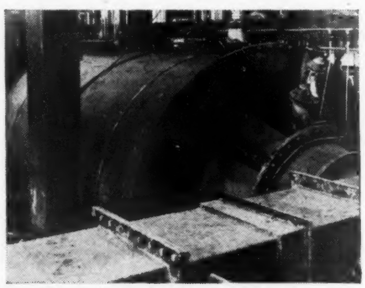
Central States

First Coal to Oil Plant Dedicated

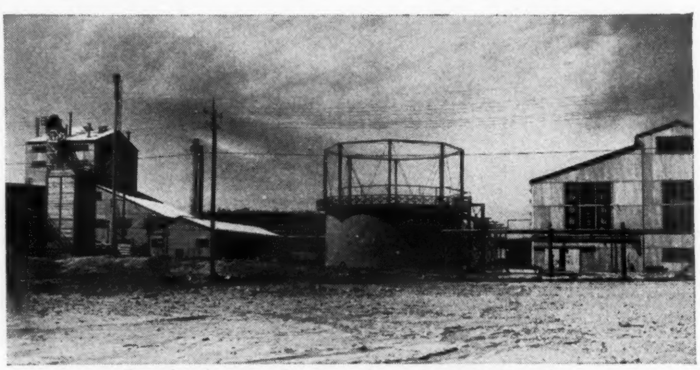
At Louisiana, Mo., on Sunday, May 8, 1949, Secretary of the Interior J. A. Krug and U. S. Representative Clarence Cannon of Missouri presented major addresses at the dedication ceremonies of the first coal to oil plant in the United States. Dr. Charles F. Kettering, general manager of the Research Laboratories Division, General Motors Corp., made a featured address at an informal dedication dinner on the previous evening.

Operation of the demonstration plants will provide a wealth of useful information essential to the adoption by industry of these processes, to use them for the commercial production of liquid fuels. Testing and further development of equipment and processes not amenable to development on a laboratory scale will be conducted. The operation of a complete integrated plant will be demonstrated. The collection, analysis, and interpretation of operating data will point the way to future improvements and refinements. A study of the process from an economic standpoint will provide detailed data for estimates of the cost of the products and of the investment required for commercial scale operation. Valuable design data will be accumulated. Engineers and operators will be trained in the required skills for a new industry.

Two types of plants have been devised to make oil and gasoline from coal. One utilizes hydrogenation principles and the other system is gas synthesis or Fischer-Tropsch. This latter plant, which is being designed and built by the Engineering and Construction Division of Koppers Co. will be in operation before the end of 1949. It will utilize any one of a variety of coals for the production of synthetic oil. The gasification unit, which is already completed, turns powdered coal into a gas. This coal derived gas is synthesized by reacting pulverized coal, suspended in a stream of oxygen, with superheated steam. The gasifier at Louisiana, Mo., produces 2,000,000 cu ft of synthesis gas per day from 28 tons per day. Following production of the synthesis gas it must be cooled and cleaned and all organic sulphur compounds must be removed.



Gasifier produces 2,000,000 cu ft of gas from 28 tons of coal



Completed units of gas synthesis demonstration plant

The catalytic process converts the synthesis gas into synthetic oil. After this plant is placed into operation some time in the fall of 1949, a distillation and conversion plant will be placed in operation to separate the raw oil into different products and to convert certain oil fractions into high octane gasoline.

Oliver Plans Ahead

In preparation for the 1949 mining program, the largest of the Oliver Iron Mining Co., Duluth, Minn., in 56 years of mining, about 32,000,000 cu yd of waste was stripped. The Gilbert pit was dewatered and water was pumped out of it at the rate of 350,000,000 gal a month in order to make the pit ready for the 1949 operating season. Careful scheduling of stripping and heavy equipment maintenance during the winter months enables most of the company's men to work a full 12-month year in contrast to the prevailing practice of the past.

Radioactive Ore Conference

The Michigan College of Mining and Technology was host on May 6 for the Conference on Radioactive Ores sponsored by the Upper Peninsula of Michigan Mineral Industries group.

Dr. Phillip L. Merritt of the AEC spoke on pitchblende, the primary source of uranium. Dr. A. H. Lang of the Geological Survey of Canada described uranium deposits in Ontario.

An exhibit of radioactive ores was on display and the ores were explained by a specialist of the U. S. Geological Survey. The program included an inspection of the radiations laboratory on the Michigan Tech campus.

Centralia Mine Closed

The Peabody Coal Co. has closed down its mine No. 5 at Centralia, Ill., as present conditions do not make operations economical.

Synthetic Diesel Fuel

A new liquid oil made from coal was tried out on a special train of the Chicago, Burlington & Quincy Railroad on May 8. The production of synthetic oil is being sponsored by the Government. The train made the run from St. Louis to Louisiana, Mo., when coal men visited the coal-to-oil demonstration plant at Louisiana.

Exploration Ups Michigan's Iron Ore Reserves

Continued exploration for iron ore, encouraged by the state law deferring taxes on newly discovered deposits, has raised Michigan's reserve supply to 3,489,459 tons over last year and to the highest point since 1937, according to the annual mine valuations report of the state conservation department's geological survey.

The 1949 reserves are estimated at 153,526,348 tons, including 67,101,475 in the Marquette Range, 55,354,831 in

Iron County, 30,511,502 in Gogebic county, and 558,540 in Dickinson county. In 1946, reserves had fallen down to 131,737,606 tons.

Isle Royale Copper Ceases Operations

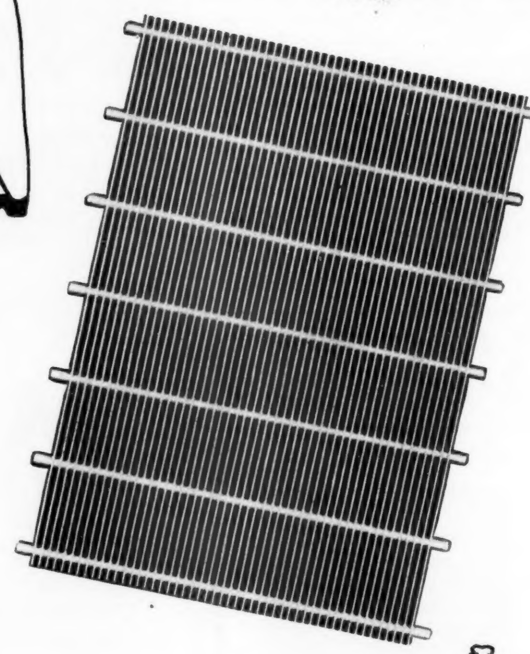
When the final skip of ore was hoisted from the No. 4 shaft of the Isle Royale Copper Co., the mine was considered exhausted. All salable items and equipment were removed to the surface, the pumps were stopped and now the mine is slowly filling. The firm is now in process of liquidating and selling its machinery and supplies.

Iron Mining Method

Studies carried on in the Iron River district of Michigan have uncovered possible methods of mining iron and other ore that otherwise could not be reached due to a heavy overlay of water-soaked sand and gravel. The studies were made to determine whether a knowledge of ground water movement could assist in reducing the costs of mine drainage. The U. S. Geological Survey in cooperation with the Michigan Conservation Department made the study.

Tailor Made

TO YOUR SPECIFICATIONS



B-Z Round-Rod SCREENS

When you buy B-Z Round-Rod Screens, Bixby-Zimmer engineers the entire installation to meet your screening specifications. B-Z Screens are "tailor-made" to your plant equipment — in any size, dimension, shape or mounting.

For all-around improved coal screening, install B-Z Screens. You'll get more exact sizing, more uniform grading and cleaner dewatering. Stainless steel, all-welded construction adds to B-Z Screen life — already multiplied by proved B-Z Round-Rod design.

Any way you look at it, B-Z Screens add up to increased profits from lower cost-per-ton screening. Write now for full facts on B-Z Round-Rod Screens.

Write Today For
FREE Booklet

A freecopy of 1949 Bixby-Zimmer Catalog, giving size and construction details, will be sent you at request. Write today.

Famous Round-Rod design allows B-Z Screens to maintain constant openings, even with 50% wear!

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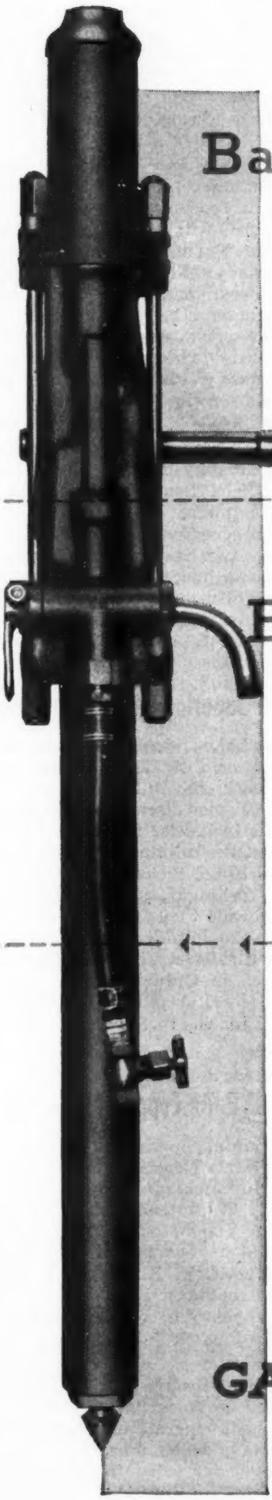
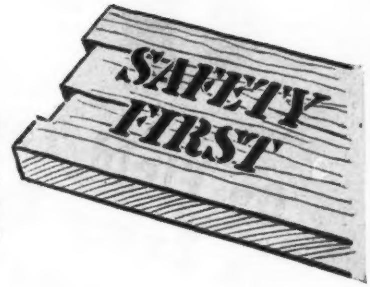


Balanced Weight

for greater safety

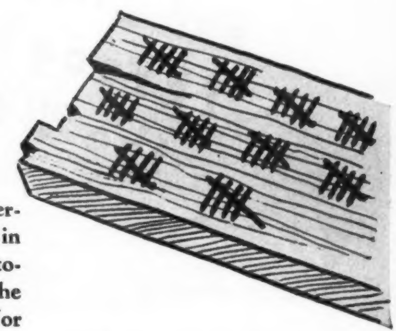


Close quarters — high scaffolding — these spots are safer for runners handling the perfectly balanced R94 Stoper. Light weight — careful weight distribution — and correctly placed holding handle practically eliminate "nose-dives."

PLUS

Balanced Power

for faster drilling



Hammer blows and feed leg push are in perfect balance at any pressure — resulting in sustained high drilling speeds. Same automatic short stroke valve that has made the Gardner-Denver R104 Stoper famous for fast drilling.

Gardner-Denver R94 Self-Rotating Stoper

Here are other big advantages of the R94:

PROTECTED AGAINST SLUDGE by constant and fully automatic flow of cleaning air.

HIGH ROTATIVE POWER. 4-pawl rotation —under finger-tip control if desired.

LONG WEARING CHUCK END preserves shank alignment and prevents weaving.

SMOOTH FEED CONTROL with a simple turn of the wrist.

CONTROLLED LUBRICATION from integral oil reservoir.

EXCLUSIVE FEED CYLINDER has tapered bushing for easy renewal.

Write today for complete information on the 100-lb. Gardner-Denver R94 Self-Rotating Stoper.

Gardner-Denver Company, Quincy, Illinois.

GARDNER-DENVER SINCE 1859

Butler Bros. 1949 Plans

Under present plans for Butler Bros. operations in Minnesota, the Patrick plant will work on a full season three-shift basis to produce an estimated 1,000,000 tons of concentrates. The ore will be obtained from the Kevin, Olson, Patrick, and Patrick Annex mines.

With a quota of 650,000 tons of concentrates, the Harrison plant will work all season on a three-shift basis. The ore will be mined from the Halobe, North Harrison, and Harrison mines. The Galbraith plant began operations about June 1 and will operate on a three-shift basis until 500,000 tons of concentrates have been produced. This figure includes approximately 150,000 tons of concentrates from the Argonne mine.

It is expected that the Weggum will produce about 700,000 tons of ore or approximately 100,000 more than in 1948. The South Agnew mine will start shipping ore as soon as some current construction work is completed, and is expected to produce 600,000 or more tons of ore in 1949 season. The 1150-B dragline installed in 1948 started stripping shortly after May 1.

Lake Superior Safety Conference

The Lake Superior Mines Safety Council held its 25th annual safety conference in Duluth, Minn., May 19-20. Topics discussed at three main sessions included "Heavy Duty Truck Maintenance in Open-Cut Mines," by Russell Kohn, Pickands, Mather & Co. A. H. Zeilinger, safety engineer of the Colorado Fuel & Iron Corp., talked on "On-the-Job Training for Production with Safety." "Hoisting Rope Research in Ontario Mines" was described by Robert E. Dye, of Dome Mines Ltd., South Porcupine, Ontario, Canada.

C&H Halts Copper Production

All mining operations at the Calumet & Hecla Consolidated Copper Co. mines in Michigan were stopped on May 1. A statement issued by the company attributed the shut-down to the sudden reversal in the demand for copper. E. R. Lovell, president of the company said, "At present there appears to be no demand for copper whatever."

The first week in May the price of copper had dropped to the level established on November 20, 1946. Mr. Lovell said operations would be resumed only when there is a demand for copper at a price which will permit operations without loss. An underground force is being maintained to operate the mine pumps.

Western States

Tungsten Mine Closes

A shutdown is planned of the Nevada-Massachusetts tungsten mine on June 25. Some 60 employes will be put out of work. C. H. Segerstrom, president of the operating company, blamed foreign competition under State Department encouragement of a low tariff, low demand for tungsten, and low price for the metal for the closing of the mine.

Star Shaft Nears Completion

The 1900-ft Star shaft at American Smelting and Refining Co.'s lead-zinc mines northeast of Silver City, N. M., will be completed next September. This shaft will replace the one now in use and will double the ore-hoisting capacity. However, the full potential capacity may not be used unless market conditions for lead and zinc warrant full operations, stated Darwin J. Pope, general manager of the company's western mining department. Sinking of the Star shaft was started in December 1947. The company proposes to start work at an early date on another shaft, this one to be carried to a depth of 4000 to 5000 feet.

Inspiration Cuts Production

Production of copper at Inspiration Consolidated Copper Co., Inspiration, Ariz., is being reduced by approximately 20 percent below the rate of output maintained during recent months, company officials have announced. This cut in production has necessitated dropping about 180 men from the payroll. Unsettled conditions in the metal market during recent weeks and the current absence of demand for copper despite the reduction in sales price were given as reasons for the curtailment of production.

Joint Chester Vein Development

Silver Summit Mining Co., which is affiliated with Polaris and Hecla, in the Coeur d'Alene district of Idaho, has announced the signing of a contract with the Silver Dollar and Silver Chieftain Mining Co. for the development of those properties on a 50-50 production basis from the 3000 level in the Silver Summit shaft. The vein system to be prospected is the Chester, which has been a good producer in Sunshine workings since 1943. The easterly extension of this vein system goes through Silver Chieftain, Silver Dollar and Chester properties. First work under the new development program is to drive a drift to a point where a 200-ft raise connection will join Silver Dollar's 2800 level, thus providing free air circulation to all the underground workings in addition to the mechanical system now in use.

Unique Uranium Ore

An interesting discovery of uranium has been made in the Vermillion Cliffs district of northern Arizona, about ten miles south of the Utah border and eight miles west of Lee's Ferry. The discoverers made their find while searching for specimens of petrified wood. The deposit was examined by Charles H. Dunning, director of the Arizona Department of Mineral Resources, and Roger I. C. Manning, field engineer. Dunning classified the material as radioactive carnotite. It occurs as a canary-yellow mineral within the petrified logs. According to preliminary estimates the deposit consists of about 200 tons of petrified logs, containing about 3 percent uranium, lying on the surface.

To make shipments of the material it will be necessary to pack the ore for about a mile and one-half by burro train, then load in trucks for hauling to the Atomic Energy Commission's vanadium-uranium plant at Monticello, Utah.

Broken Hills Starts Production

Production of lead-silver-zinc ore from its Broken Hills property began in May by the Broken Hills Mining & Milling Co., near Fallon, Nev. The Westgate mill, 20 miles from the mine, is being reconditioned and equipped with more machinery. It has a daily capacity of 50 tons. The company plans to eventually mill 100 tons a day including custom product. Operations were moved last year from the Belmont shaft to the Crown Point shaft, which is 800 ft deep. An ore body exposed in the Crown Point is said to be 6 ft wide, averaging $30 a ton.

Program Committee Sets Pattern for 1949 Metal Mining Convention

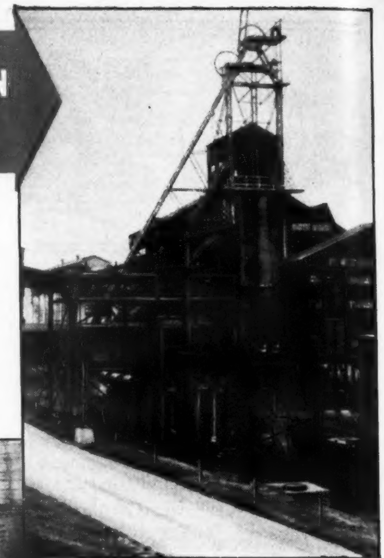
Drilling out the stope in preparation for the big blast, State Chairmen of the Program Committee met on June 7 in Spokane, with William J. Coulter, general manager, Climax Molybdenum Co., National Chairman of the Program Committee, and Stanly A. Easton, president, Bunker Hill & Sullivan Mining & Concentrating Co., and Chairman, Western Division, American Mining Congress. They faced a tremendous task when they gathered. The splendid cooperation of the entire metal and nonmetallic mining industry had resulted in a great variety and number of topics of value and interest from which a selection had to be made to fit the limitations of a three-day program.

Knuckling down to its all-day job the meeting proceeded to choose subjects and arrange for speakers to discuss the most important economic and operating problems which confront the mining industry today. The preliminary program will be outlined in the July issue of Mining Congress Journal.

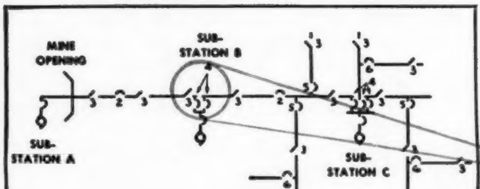
General arrangements for the Spokane Convention, September 26, 27 and 28, are well under way. Enthusiastic committees headed by R. M. Hardy, General Chairman, and Roger Oscarson, Vice-Chairman are working out preparations for a fine three-day meeting.

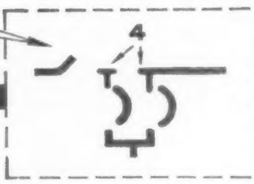
The Chairman of the Housing Committee has guaranteed a total of 1,000 rooms conveniently located in the city of Spokane, and a number of attractive motor courts can house many people who are driving to the meeting. Anticipated attendance is heavy and those who plan to attend are urged to reserve accommodaions now with the Housing Committee, 1949 Metal Mining Convention, Davenport Hotel, Spokane, Wash.

How to SECTIONALIZE for HIGHER PRODUCTION
Follow these I-T-E recommendations



One of the surest ways to raise mine production levels is to cut down on time and work lost because of electrical disturbances. I-T-E presents these recommendations to show you how proper applications of I-T-E Sectionalizing Switchgear can pay off for your mine by holding electrical disturbances to an absolute minimum, and by assuring greater safety for personnel and equipment.





THE RECOMMENDED D-C SECTIONALIZING PRACTICES:

Key

1 In each of the following cases, sufficient feeder and return circuit capacity should be provided so that the overcurrent protective device will be opened by a dead short-circuit at the most remote point of the circuit.

2 An overcurrent protective device should be installed between each two substations at such a point in the circuit that the resistance between each station and the device is approximately the same.

3 A disconnect switch or protective device should be placed at not more than 1,500 ft. intervals in every power line.

4 An overcurrent protective device should be used in each circuit leaving a substation. If automatic reclosing circuit breakers are employed for this, trip-free operating mechanism should be used.

5 An overcurrent protective device should be placed at each main-branch circuit.

6 Each mining setup should be protected by an overcurrent protective device. In some cases, it may be necessary to protect two setups by one device.

● Minimizing electrical disturbances by confining them only to the affected circuits is one of the prime advantages of a properly sectionalized distribution system. By utilizing I-T-E Type KSC Automatic Reclosing Circuit Breakers for the duty above — that of protecting circuits leaving substations — you can safely, effectively confine faults to the line on which they occur.

The KSC operates on circuits which can be fed in either direction; opens quickly at first sign of short or overload — recloses automatically on a return to normal line conditions. And the KSC mechanism is electrically trip-free — it cannot be held closed against a fault. For complete information on the I-T-E Type KSC — the only circuit breaker developed specifically for the mining industry — write for Bulletin 4611.

Find out how you can benefit from proper applications of I-T-E Sectionalizing Switchgear in your mine — consult the I-T-E Mining Specialist in your locality. He thoroughly understands the Bureau of Mines' new recommendations for installing and using electrical equipment in coal mines, and is fully qualified to assist and advise you in planning the sectionalization of your distribution system. Use his services without obligation.

Be Production-Wise . . . Sectionalize!

I-T-E

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SWITCHGEAR

I-T-E CIRCUIT BREAKER CO., 19TH & HAMILTON STREETS, PHILADELPHIA 30, PA.

31 OFFICES IN THE UNITED STATES • In Canada, EASTERN POWER DEVICES, LTD., TORONTO

SWITCHGEAR • UNIT SUBSTATIONS • AUTOMATIC RECLOSING CIRCUIT BREAKERS

Anaconda Closes Zinc Mine

Officials of the Anaconda Copper Mining Co. in Butte, Mont., gave the unstable condition of the metals market as the reason for closing down the Lexington mine, one of Butte's zinc producers, in April. The 175 men employed at the mine were transferred to other mines of the company in Butte. The Lexington is one of the oldest zinc mines in the Butte camp and is one of the four zinc properties that have been operating since the war period.

Nevada Dredge Operation

Natomas Co.'s dredge at the Greenan placers in Lander County, Nev., was placed in operation in May. Greenan operations are 18 miles south of Battle Mountain and had been worked by dragline with poor economy owing to heavy charges and forced closedowns. In 1947, Natomas purchased the dredge of the Manhattan Gold Dredging Co. which was dismantled and moved from Manhattan Gulch to Greenan placers. There it has been rebuilt with an extended digging ladder and stacker for use in deeper ground.

New Dredging Unit

Tests are over and preparations to begin dredging were under way in May on a gyro-concentrator designed for recovery of flour gold along Idaho's Snake river. Workings are located about 41 miles west of Pocatello. The dredge, constructed under supervision of George Fenton, Boise, houses 14 of what A. A. Johnston, Portland, Ore., inventor and mathematician who perfected vital parts of the machine, termed "gyratory concentrators." The drum-shaped machines are 36 in. high, 27 in. in diameter and consist of four superimposed pan-type units. The concentrators receive feed from conventional vibrating screens. The concentrators so move that, as the water spirals and churns, sinking of the suspended solids is forced and the fine or "flour" gold heretofore lost in dredging operations is retained in a depression at the bottom of each otherwise cylindrical pan.

J. H. Heginbotham, manager and metallurgist of the General Engineering Co., Salt Lake City, said his tests show 88.79 percent recovery with the Johnston invention, in fire assays. The owners estimate handling costs at 10 cents a yard, well below the actual recovery shown in field tests.

Sink-Float Improvement

C. Y. Garber, superintendent of the Bunker Hill & Sullivan mill, in Idaho, and his assistant, Frank M. McKinley, have been granted a patent on an improvement in the sink-and-float process of separating minerals, and have assigned their patent to the Sink and Float Corp. Standard practice has been to introduce the feed from the top in the sink-and-float unit, but the Garber-McKinley idea is to introduce the feed into the center of the separating medium, where quicker action results are obtained in separating the waste from the ore-bearing material, the waste, being lighter, quickly goes to the top, where it is automatically skimmed off, while the heavy material sinks to the bottom to an automatic conveyor system. The new idea was successfully tried out at the Bunker Hill before patent was applied for.

Hercules Produces Again

Day Mines, Inc., has brought the old Hercules mine at Burke, Idaho, back into production after it has been closed down for a period of 30 years, and the company announces the old mine is now supplying five percent of the company's ore tonnage.

Park City Mill Closes

As a result of recent declines in metal prices, Pacific Bridge Co., has suspended its Park City, Utah, mill operations indefinitely, S. W. Norton, manager announced. The company had been operating a 1000-ton daily capacity mill for the past three years, retreating tailings from early day mill operations and recovering lead and zinc. Mr. Norton said the shutdown was due directly to metals price reductions which have resulted in a decline of about 38 percent in gross income of the Park City operations during the past two months. This is the first shutdown announced in Utah as a result of price drops. Several mines have reported cutbacks in production.

Taylor-Knapp Mill Rebuilt

Rebuilding of the portion of the Taylor-Knapp mill in Philipsburg, Mont., destroyed by fire on April 16, was commenced on April 18, according to company officials. The mill was back in operating condition by May, although there are considerable repairs to be done which will not interfere with mill operations. The mill treats manganese ore from the Philipsburg district.

Idaho Mine Association Meets

In the picturesque setting of Sun Valley, Idaho, mining men from the Northwestern States met, June 13-15, to hear a series of addresses by prominent men associated with the industry.

The first day of the three-day meeting was opened by Harry W. Marsh, secretary, Idaho Mining Association. C. A. Robins,, Governor of Idaho and A. E. Stoddard, president, Union Pacific Railroad, welcomed the group and commented briefly on the association's importance to the welfare of Idaho. Julian D. Conover, Secretary, American Mining Congress, first speaker on the program, assessed "The Impact of the 81st Congress on Mining." Idaho and the atomic energy scene was summed up by John Parks. G. S. Borden analyzed current income tax problems including a discussion of depletion and the treatment of exploration and development expenditures.

Tuesday morning was marked by an address on "The Shifting Scenes in Lead" by Robert F. Ziegfeld, secretary, Lead Industries Association. Ernest V. Gent, secretary, American Zinc Institute, Inc., discussed the current zinc situation and stockpiling was considered by Col. F. H. Holmes of the Munitions Board. A paper on the phosphate deposits of Idaho was presented by E. M. Norris. Neil O'Donnell, executive vice-president, Idaho-Maryland Mines Corp., spoke on the advantages of a free market for gold and A. W. Fahrenwald, dean, school of mines, University of Idaho, presented a paper on some crushing and grinding results.

Dr. James Boyd, director, U. S. Bureau of Mines, outlined the natural resource program of the Bureau, on Wednesday morning. The mining industry's stake in the Bureau of Land Management was treated by Daniel L. Goldy, regional administrator, Region I, Bureau of Land Management. A paper entitled "Romance of Phosphate" was presented by J. D. Miller, resident manager, Westvaco Chemical Division.

The off-hour activities at the annual meeting included a buffet dinner on the Lodge terrace, a trip to the top of Bald Mountain on the ski lift, and the annual banquet keynoted by the declaration of policy.

Presiding over the sessions were J. B. Haffner, general manager, Bunker Hill & Sullivan Mining & Concentrating Co. and president, Idaho Mining Association, on Monday; A. H. Shoemaker, manager, Triumph Mining Co. and vice-president of the association, on Tuesday; and John D. Bradley, executive vice-president, Bradley Mining Co., on Wednesday. Harry W. Marsh, secretary, Idaho Mining Association, deserves high praise for his fine year-round work in the interests of Idaho mining.

A.S.&R. Plans Copper Development

American Smelting and Refining Co. is preparing to develop 30 copper claims in the Stillwater area of Nevada, 42 miles southeast of Lovelock, following tests of the property by core drilling. The company leased and optioned the claims last summer from Airlanes Gold-Copper Co. Located on a copper belt 18 miles long, the property was core-drilled last year by the U. S. Bureau of Mines to a depth exceeding 200 ft over an area several hundred feet wide and 3000 ft long.

Hailey Area Study Planned

The Idaho Bureau of Mines and Geology plans to concentrate its technical staff on a study which may lead to revival of large scale mining in the Hailey area of Blaine county, Idaho, it was recently revealed, in a report to the bureau's board of control. This area includes Camas, Galena, Mineral Hill, Little Wood River, Warm Springs and other places. It was once one of the most productive areas in Idaho, second only to the Coeur d'Alenes. The Hailey area has produced lead, silver, gold, copper and zinc worth $30,000,000.

Anaconda Options Tombstone Claims

The Tombstone Development Co. has optioned its 91 mining claims in the Tombstone, Ariz., district, to Alexander M. McDonald, representative of the Anaconda Copper Mining Co. According to Jack B. Martin of Tucson, president of the Tombstone Development Co., the claims comprise about 1000 acres of patented land, and include such famous old properties as the Lucky Cuss, Toughnut, Emerald, Silver Plume, and others. Terms of the option give Anaconda 90 days for exploratory and geological surveys. At the end of that time, August 1, the company agrees to make a substantial payment before starting mining operations or forfeit the option.

Between 1879, when the Tombstone mines were discovered by Ed Schieffelin, and the present time, the claims have produced ores valued at close to $40,000,000. The Tombstone Development Co. was organized in 1934 and operated the mines until 1938. Its production during that period is said to have exceeded $2,000,000. Work was halted at the 500 level because of water difficulties and since then the only production has come from leasing operations in the upper levels.

Cardiff Finds New Ore

Ore discovery in "favorable grades" on the 1350 level of the Cardiff mine, in Utah, was reported in May by Lee Hicks, leaser. Installation of a heavy capacity pump is planned to facilitate operations.

Reisbeck Shaft Sinking

Sinking of a 250-ft shaft is proceeding at the Reisbeck gold-silver property, in the Sand Springs district, east of Fallon, Nev. Installation of a hoist, compressor and other machinery was completed last December. The Reisbeck endlines the Summit King property, operated by Summit King Mines, subsidiary of Bralorne Mines of British Columbia, and was formerly worked through a 150-ft shaft.

Wheels of Government

(Continued from page 84)

met on May 21 following receipt of your first letter, I explained that the United States Steel Subsidiaries signatory to the National Bituminous Coal Wage Agreement of July 13, 1948, represented by me, preferred to negotiate with you after, rather than before, you have concluded a new contract with the commercial operators who produce over 90 percent of the tonnage in the industry. If, however, you are adamant on an earlier meeting, I will, of course, meet with you at a time and place convenient for you, preferably after June 10, 1949."

Coal Mine Inspection

Between May 18 and 31 Senator Neely's (Dem., W. Va.) Labor and Public Welfare subcommittee conducted hearings on his bill, S. 1031, to grant police powers to Federal coal mine inspectors. The measure amends the Coal Mine Inspection Act of May 7, 1941, to provide that upon detection of imminent danger to employes a Federal coal mine inspector shall immediately order the operating manager or his representative in the mine to withdraw men from the unsafe area.

Proponents of the Neely bill were led by John J. V. Forbes, chief, Health and Safety Division, U. S. Bureau of Mines; C. F. Davis, safety director, UMWA; and UMW president John L. Lewis. Vigorous opposition to the invasion of the police powers of the States was registered by heads of the State Mining Departments of Pennsylvania, West Virginia, Kentucky, Maryland and Wyoming.

The mining industry's opposition was voiced by representatives of the West Virginia Coal Association, American Mining Congress, National Coal Association, Colorado & New Mexico Coal Operators Association, Alabama Mining Institute, Kanawha Coal Operators Association, Big Sandy-Elkhorn Coal Operators Association, Utah Fuel Co. and others. Emphasizing that a centralized Federal police power is not and never has been the answer to coal mine explosion and accident reduction, the American Mining Congress urged the Committee and the national Congress to call in the Secretary of the Interior and the Director of the U. S. Bureau of Mines and initiate, with sufficient appropriations, a comprehensive program of research and education in the prevention of mine accidents and mine explosions.

Manufacturers Forum

Improved Cap Lamp

A new Edison electric cap lamp is reported to give 25 percent more light than available from previous units. The new lamp is the result of years of work at the Nela Park laboratories of General Electric Co.; Thomas A. Edison, Inc.; and the Mine Safety Appliances Co. The new cap lamp has a four-cell battery design but does not

have any appreciable change in size compared with preceding three-cell model. The lamp's batteries retain Edison's original nickel-iron-alkaline principle. The four steel-sheathed cells of the new battery are now encased in a tough nylon plastic container that is molded in one piece and resistant to abrasion, corrosion, and moisture.

A feature of the new lamp is that it can be focused without dissembling the headpiece. By a simple adjustment, miners can focus the lamp to provide a spotlight beam that will penetrate long distances. All exposed parts of the battery case are made of stainless steel. Designed for comfort, the new lamp is said to be worn comfortably for long periods.

New Walking Dragline

A new walking dragline with bucket capacities ranging from 8-12 cu yd and booms from 165-205 ft has been announced by Bucyrus-Erie Co., South Milwaukee, Wis. The new machine, the 500-W, incorporates some of the features of the 650-B and 1150-B strippers, notably the individual drag and hoist motors and the twin drag lines.

Working weight of the 500-W is 1,275,000 lb. Maximum dumping height is 107 ft. With a 205-ft boom, at the standard working angle, the excavator can dig 135 ft below the surface on which it rests. Material can be moved 416 ft horizontally without throwing the bucket. The unit walks with 7-ft 4-in. steps on shoes that are 37 ft long and 6 ft wide.

Electric Car Shaker

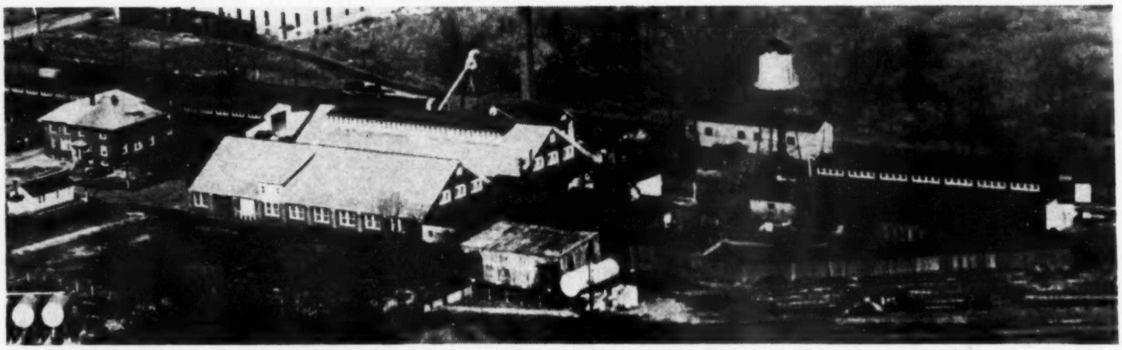
For speeding up the unloading of coal, cinders, ore, slag, coke and other granular materials from drop-bottom gondola cars, Allis-Chalmers, Milwaukee, Wis., has developed a new car shaker. The unit is designed to fit all sizes of drop-bottom gondola cars operating in North America. The heavy steel body of the shaker contains a vibrating mechanism, motor, and Texrope drive. Placed on the top flanges of a car by hoist or crane, the shaker transmits its vibratory motion to the car and loosens the material so it flows through the hopper openings. A 15-hp, totally-enclosed, rubber-mounted, high-torque drive motor powers the car shaker.

Diesel Maintenance Training

In recognition of the industry-wide need for skilled service personnel to maintain the Diesel engines of operators who utilize large fleets of Diesel powered equipment, Detroit Diesel Engine Division of General Motors Corp. has developed a "Mobile Training Unit" for instructing owners and operators of General Motors Series 71 Diesel engines. Complete training service facility is obtained in a two-ton, cab-over-engine truck. Its classroom equipment includes a cutaway model of a three-cylinder GM Series 71 Diesel, a fully equipped standard engine, monometer testing apparatus, cutaway sections of principal sub-assemblies, charts, movies, slides, and many other pieces. Two experienced instructors handle the teaching assignment.

The unit is now touring the country with a special program. The two- or three-day-long courses are divided into five major parts covering operating characteristics, engine construction, maintenance and repair, engine tune-up and diagnosis, and intelligent preventive maintenance procedures.

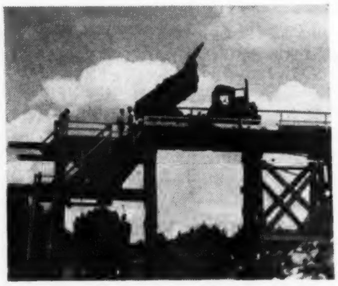
Demonstrating engine tune-up procedures



National Mine Service Co. has purchased the assets and business of Whiteman & Co., distributors of mine supplies and equipment with offices and warehouse in Indiana and Altoona, Pa. The newly acquired company will become the Whiteman Division of National Mine Service Co. and will operate under direction of L. W. Householder, vice-president.

Rear-Dump Trucks

A new model rear-dump Euclid, produced by the Euclid Road Machinery Co., Cleveland, Ohio, was displayed for the first time at the 1949 Coal Show. The new model, powered by two 190-hp Diesel engines, has a payload capacity of 34 short tons.



The design is such that each engine drives one of the rear axles to a torque converter. There is no clutch pedal or manual shifting of gears—the operator can change to the desired gear under full power at any travel speed. Top speed with full 68,000-lb payload is 25.4 mph. The photograph shows one of these trucks at the Troy Mine near Eveleth, Minn. There the Cummins-powered Euclid makes up to 40 round trips per shift on a two and one-half mile, round-trip haul from the pits to the railroad tower, working on a long, steep grade.

Coarse Material Drum Separator

A drum separator designed to treat particle sizes ranging up to 8 in., in capacities up to 420 TPH, is being produced by the Western Machinery Co., San Francisco. The Wemco drum separator, now in production, is said to incorporate a number of exclusive design features for mineral dressing and coal preparation.

The new machines are available in ten sizes from 6-14 ft. Wemco drum separators of appropriate size are offered as a component part of the WKE (HMS) Mobil-Mill, the semi-portable, prefabricated, mineral-beneficiation plant. Small units, 30-in. diam by 30 in. long, are available for continuous laboratory and pilot mill investigations.

Power Distribution

The new Harmattan mine of the Fairview Collieries Corp., near Danville, Ill., has installed a GE power distribution system for its coal-stripping operations. The system consists of a 1500-kva outdoor-type, skid-mounted, single-circuit substation, a type EW grounding resistor, three single-pole Form G Thyrite station-type lightning arresters, five metal-enclosed, portable, hill-type and four pit-type cable skids, and 20,000 ft of portable cable.

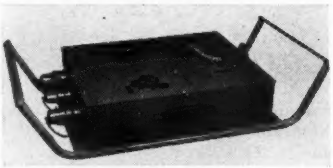
Permissible Blasting Unit

A single shot permissible blasting unit is being produced by the Austin Powder Co., Cleveland, Ohio, which has no batteries, gears, cams, springs,

or other parts of this type. In operation of the rubber-covered, 17-oz unit, a simple key is used to tilt a spade-like armature across the lines of force established by permanent magnets. An electrical impulse thus generated is of sufficient magnitude to fire an electric blasting cap through 4.5 ohms resistance.

Safety Circuit Center

A low-height, dust resistant safety circuit center with automatic breakers is being produced by Mines Equipment



Co., St. Louis, Mo., designed to serve low-seam mining operations. The unit incorporates the same safety features that have been developed for use in thick-seam operation by this company.

Self Loading Truck

The Eimco Corp., Salt Lake City, recently announced production of a "Transport Rocker Shovel" which digs, loads, and carries materials such as large rock, ore concentrates, gravel or sand. The Model 15 unit is powered with either electric motor or gasoline engine. It is designed to permit operation in narrow passageways and can make right-angle turns and travel up and down ramps.

Resistance Elements Detects Load Changes

Resistance wire strain gage devices produced by the Baldwin Locomotive Works may be used to detect and measure changes of stress or load, and minute deflections in various types of service. A centrifugal filter built by the

Bird Machine Co. which dewaters 20 to 30 tons per hour of coal under 5/16 in. in size at the Champion coal preparation plant of Pittsburgh Coal Co. at Imperial, Pa. The load beam is said to operate at 300 lb force. Filters are controlled by the Foxboro Dynalog Recording Controller which utilizes the SR-4 load-beam detector unit. The SR-4 gages detect torque changes and the change of resistance affects an electronic controller circuit. Translated into pounds of load on the recorder chart, supervisors know the conditions under which the filter is operating. If the filter load exceeds a set value, the feed is automatically cut off until the machine has cleared itself.

Re-Railer and Splice Bar

For use at points of frequent derailment, Mining Machine Parts, Inc., Cleveland, Ohio, has available the "Biggie Guard Rail" which combines a re-railer and splice bar. The one-piece alloy steel unit for continuous or intermittent duty at frogs, switches, and short turns, can be attached in a short time without punching, drilling, or special tools. It is suitable for use with prefabricated track. Bolts, spacers, and other obstructions to wheel flanges are eliminated.

Lamp Bracket

A lightweight plastic molded lamp bracket that accommodates any type of electric or carbide lamp has been developed for the Bullard Hard Boiled Hat. This bracket is now standard equipment on all hats ordered with brackets attached from the E. D. Bullard Co., San Francisco, Calif.

Safety Hose

A mine sprinkler hose, colored a bright yellow, is designed to improve safety underground by eliminating accidents caused by hose that could not be seen. The new safety hose, produced by the mechanical goods division of the Goodyear Tire & Rubber Co., is manufactured in ¾-in. size only. It is constructed with high tensile rayon yarns, covered with abrasive-resistant rubber stock.

— *Announcements* —

R. P. Connette has been appointed assistant to the president of the **American Car and Foundry Co.**, with headquarters in New York City.

C. C. Carr, director of public relations and advertising for **Aluminum Company of America**, retired from active service on June 1. He was succeeded by **Arthur P. Hall**, who has been assistant director of public relations and advertising since December 1, 1947.

Shoemaker & Sons, Inc., Empire State Building, N. Y., have been appointed district representatives covering the Middle and North Atlantic area for **Georgia Iron Works Co.**, Augusta, Ga., manufacturers of hydraulic mining equipment, slurry pumps, and accessories.

Chester H. Sanderson has been appointed advertising manager of **Mine Safety Appliances Co.**, Pittsburgh, Pa.

J. F. O'Brien has been appointed general sales manager of **Vulcan Iron Works**, Wilkes-Barre, Pa.

V. L. Snow has been appointed domestic sales manager of the **Euclid Road Machinery Co.**, succeeding the late W. W. Paape.

John Z. Linsenmeyer has been appointed manager of mining, petroleum, and chemical engineering for the **Westinghouse Electric Corp.**, according to an announcement by J. C. Fink, manager of the company's industry engineering department. Mr. Linsenmeyer succeeds **Phelan McShane**, who has been appointed consulting mining engineer for the company.

V. B. Graves, formerly representative for the Jeffrey Manufacturing Co., is now representing the **Fairmont Machinery Co.** in the southern coal field.

Paul E. Lundquist has been appointed sales manager of the newly formed construction division of **Pettibone Mulliken Corp.**

Robert L. Baldwin was recently appointed assistant to **G. A. Wallerstedt**, western district manager for **Hardinge Co., Inc.** Mr. Baldwin will assist in sales development, using the San Francisco office as headquarters.

John R. Shoffner, consulting engineers, have changed their location to 120 Market St., Kittanning, Pa.

MacMen, Inc., Los Angeles, has been organized to meet the rising demand in mining and other industries for trained specialists capable of installing major equipment for any type of plant.

To fill the newly-created position of executive vice president, the board of directors of **American Hoist & Derrick Co.** have elected **Stanley M. Hunter**, according to a recent announcement.

CATALOGS AND BULLETINS

COAL MINING PROGRESS. *West Kentucky Coal Co., Madisonville, Ky.* An attractive 20-page booklet entitled "Coal Mines by Machines," is well illustrated with sketches and full-color paintings to document the progress made by the company during its 75 years of coal mining operations during which it produced over 117,000,000 tons of coal. The booklet shows that the modern mechanized underground mine is clean, well-lighted, and well-ventilated. Copies of this attractive booklet are available from the company.

HEAVY-MEDIA. *Nelson L. Davis Co., Chicago.* An illustrated brochure describing the services of the company as a Heavy-Media processor for the coal producing industry. Recommended arrangements for recovering clean coal from various types of seams are illustrated with flow sheets.

SHOCK AND WEAR RESISTANT GEARS. *Pittsburgh Gear Co., Pittsburgh, Pa.* A new catalog-line of Armored gears and crane wheels for steel mills, coal mines, industrial plants, etc., where a need to withstand more than ordinary shock and wear has been announced. The producer guarantees these gears, made of special specification steel and armored by a company process, to give an average service life five times that of untreated gears, one to one and one-half times that of oil-treated gears and equal or superior to the average life of any other heat-treated gear in identical service. Copies of the catalog are available upon request.

A QUARTER CENTURY OF ACHIEVEMENT. *Peter F. Loftus Corp., Pittsburgh, Pa.* A brochure bearing this title outlines the activities and accomplishments of the corporation in the field of consulting engineering. Much of the early work of this corporation was in the coal-mining industry and the work being done now covers a wide field of design engineering, from steam power plants to large industrial enterprises. This well illustrated booklet highlighting many types of engineering projects is available upon request.

V-BELT DRIVES. *B. F. Goodrich Co., Akron, Ohio.* A new catalog section on its Multicord and Grommet Multi-V belts has been published showing cross section of the Multi-V belt and giving belt numbers, sizes, and pitch lengths. One feature of the section is a suggested procedure for designing drives using the company's Multi-V belts. The problem is outlined, step-by-step methods given, and the solution of the problem revealed.

WIRE ROPE. *The Colorado Fuel and Iron Corp., Wickwire Spencer Steel Division, Palmer, Mass.* On the 50th anniversary of wire rope making at the Wickwire Rope mill at Palmer, Mass., the company has issued a catalog of charts, tables, drawings, and photographs of value and interest to all users of wire rope. The first section of the catalog covers wire rope characteristics; the second section, divided into six parts, describes wire rope for specific purposes; and the third section deals with the care and handling of wire rope. Copies may be obtained without obligation by writing to the Colorado Fuel and Iron Corp., Wickwire Spencer Steel Division, 500 Fifth Avenue, New York 18.

— Index To Advertisers —

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